Navtel
4000

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INSTRUCTION MANUAL

4950AA ELECTRONIC COUNTER

The 4950AA Electronic Counter is a special version of 4000 series counter 4950A-03. The unit was designed primarily for functional testing of D.M.E. and V.O.R. equipment. Modifications and specifications for the instrument are described in an appendix to the 4000 series manual which follows.

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Appendix

A-1 INTRODUCTION.

The 4950AA electronic counter is a special version of the 4000 series counter 4950A-03. The unit was designed primarily for functional testing of D.M.E. and V.O.R. equipment. The counter is supplied for rack installation in a standard 19 inch x 3½ inch rack. A front panel attenuator provides selectable attenuation factors of X1, X20, and X50. Special changes to the instrument are detailed in this appendix.

A-2 SPECIFICATIONS

The specifications for the 4000 series apply to the 4950AA except as noted in the following table.

INPUT A	
Input Impedance:	1M OHM with 60 pF max.
Sensitivity:	50 mV RMS up to 80 MHz. Decreasing to 150mV at 125 MHz.
Overload:	150 V RMS up to 1 KHz, decreasing to 5 V RMS. at 125 MHz steady state. 100 volts DC and peak AC when attenuator is switched.
INPUT B	
Sensitivity:	50 mV RMS 80 MHz to 1250 MHz.
TIME BASE	
Aging Rate:	± 1.2 ppm/year
Line Voltage:	± 0.1 ppm for 10% change
Temperature Stability:	± 1 ppm for 0^{o} - 40^{o} C.

A-3 OPERATING INSTRUCTIONS.

The sensitivity control of the standard 4950A has been replaced by a front panel selectable attenuator. The attenuator control provides attenuation factors of X1, X20, and X50 on the A channel amplifier. Due to the high noise content of the DME/VOR signals, the higher attenuator factors should be used whenever possible, and advancing the control to X20 or X1 only when the input level is not sufficient for a reliable reading. For frequencies over 80 MHz the B channel amplifier should be used. The overload specification for this channel is 5 volts RMS; care should be taken not to exceed this value.

A-4 THEORY OF OPERATION DIRECT AMPLIFIER.

The direct amplifier for the 4950AA is shown in figure A-1. The 5 Hz to 125 MHz input signal is coupled by C1 to the attenuator section R1, R2, R3. The attenuation factor is selected by S101 and the appropriate relay (K1, K2 or K3) is energised. The signal is fed to a FET buffer Q1, and Q2 whose input is protected by diodes CR1 and CR2. The output of the buffer feeds a wideband amplifier Q3. The output of Q3 feeds a series of three operational amplifiers (contained in a single package, AR1). Each amplifier is equipped with a double ended input and output. A reference voltage line biases the first amplifier.

A-5 REPLACEABLE PARTS.

The illustrated parts breakdown for the 4950AA direct amplifier (p/n 085497) is contained in this section. For all other components refer to section 5 of the main manual.

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	4950AA Direct PCB Assembly	085497			
	Figure A-2	081463		4900-1002	1
C1	CAp., MYLAR, 0.1uf, 10%, 250V	011131	73445	C280AE/A100k	1
C2	CAP., DISC, 100 pf. 10% 1 KV	011111	56289	CQ30B102H 100	1
C3	CAP., DISC, 10 pf. 10% 1 KV	011101	56289	CB30B102H 010	3
C11					
C12					
C4	CAP., TA., 47 uf, 20%, 15 V	011205	56289	1960476X0 015	1
C5	CAP., CER, DISC, 47 pf, 20%, 500 V	011108	56289	CO30B102H4 70J	3
C13					
C14					
C6	CAP., CER, DISC, 0.01 uf, 20%, 25 V	011127	32897	5835-000U5U 103B	2
C9					
C7	CAP., TA., 10 uf, 20%, 16 V	011201	56289	196D106X00 15 JA1	2
C10					
C8	CAP., TA., 22 uf, 20%, 20 V	011204	56289	196D226X00 20 LA3	1
CR1	Diode, UCTRA Fast Switch, S1	031914	07263	1N914	2
CR2					
K1	Relay, Picoreed, DIP	049001	C.P. Claire	PRME 1A005C	3
K2					
K3					
Q1	Trans., FET, H.F., SM. SIG.	033404	17856	E310	1
Q2	Trans., H.F., NPN	033305	01295	BF357	2
Q3					
Q4	Trans., S1., NPN	033101	07263	2N5771	1
R1	RES., ¼W, 5%, C.C., 1 MEG	022510	01121		1
R2	RES., ¼W, 5%, C.C., 47 K	022347	01121		1
R3	RES., ¼W, 5%, C.C., 22 K	022322	01121		1
R4	RES., ¼W, 5%, C.C., 82	022082	01121		1
R5	RES., ¼W, 5%, C.C., 470 K	022447	01121		1
R6	RES. ¼W, 5%, C.C. 270	022127	01121		1
R7	RES., ¼W, 5%, C.C. 150	022115	01121		1
R8	RES., ¼W, 5%, C.C. 10 K	022310	01121		1
R9	RES., ¼W, 5%, C.C. 68 K	022368	01121		2
R16					
R10	RES., ¼W, 5%, C.C. 560	011156	01121		6
R17					
R18					
R23					
R24					

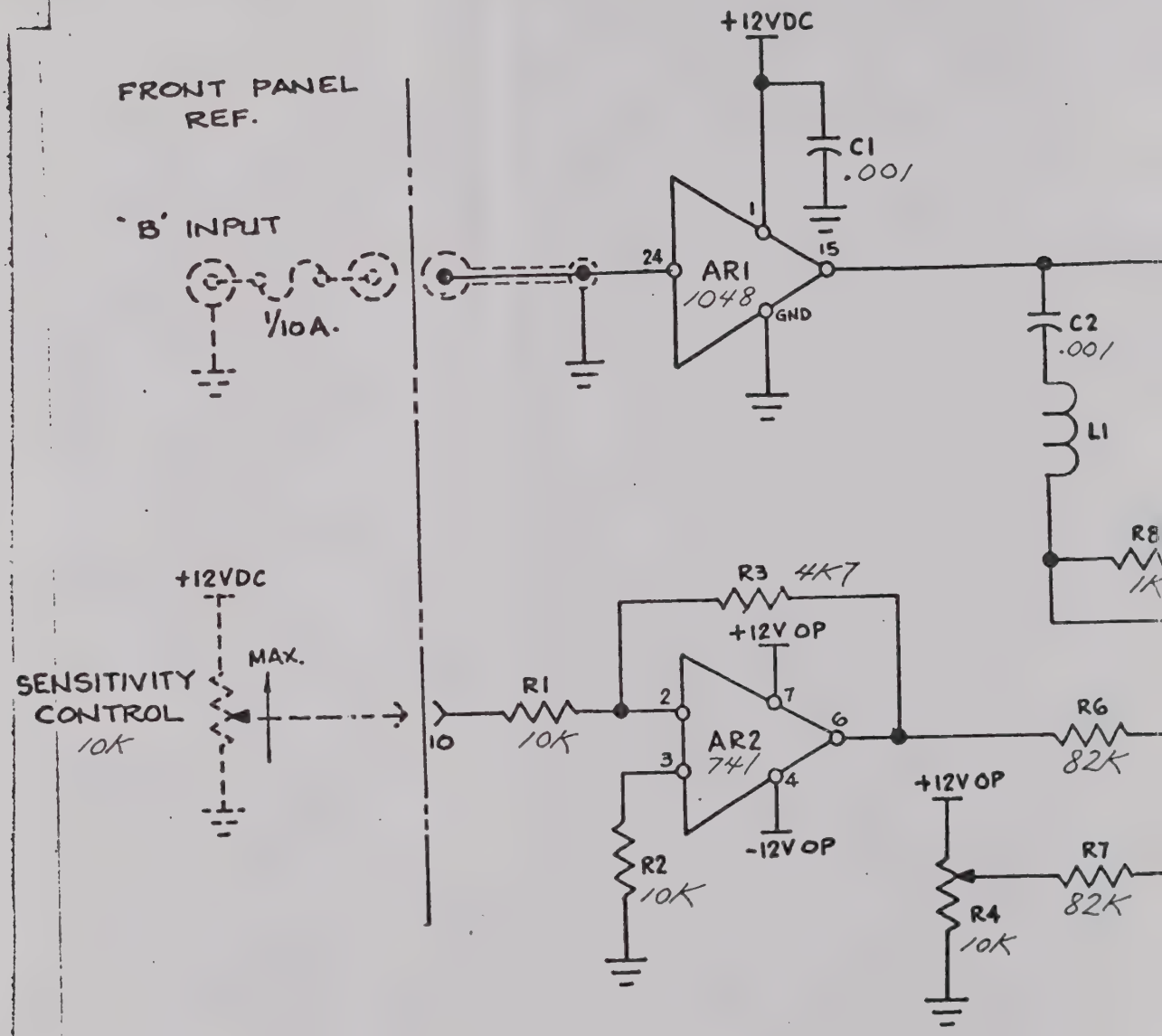
REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
R29					
	PCB ASSEMBLY (Cont'd)				
R11	RES., ¼W, 5%, C.C., 100	022110	01121		1
R12	RES., ¼W, 5%, C.C., 10	022010	01121		1
R14	RES., ¼W, 5%, C.C., 2 K 7	022227	01121		4
R15					
R25					
R28					
R19	RES., ¼W, 5%, C.C., 270	022127	01121		2
R20					
R21	RES., ¼W, 5%, C.C., 330	022133	01121		
R22					
R26	RES., ¼W, 5%, C.C., 390	022139	01121		1
R27	RES., ¼W, 5%, C.C., 5 K 6	022256	01121		2
R28					
R13	RES., TRIMPOT, 10 K LIN.	027310	FIHER	PT-10H-10K	1
AR1	L.C. & Triple Line Receiver, DIP 14 PIN	047117	07263	F95116	1
AR1	Socket, I.C., Low Profile, 16 PIN	061216	01295	C931602	1
S101	Switch, Rotary 3 Position	063101		1461	1
W5					
2	Coax Cable Assy. 3 inches	071617		RG174/u	1

TO BE SUPPLIED IN FINAL MANUAL

FIGURE
BATTERY PCB SCHEMATIC

TO BE SUPPLIED IN FINAL MANUAL

FIGURE 6-7
DATA OUTPUT UNIT PCB SCHEMATIC



R5 NOT USED

UNLESS OTHERWISE STATED
RESISTORS IN OHMS, 5%, 1/4W
CAPACITORS IN MICROFARADS

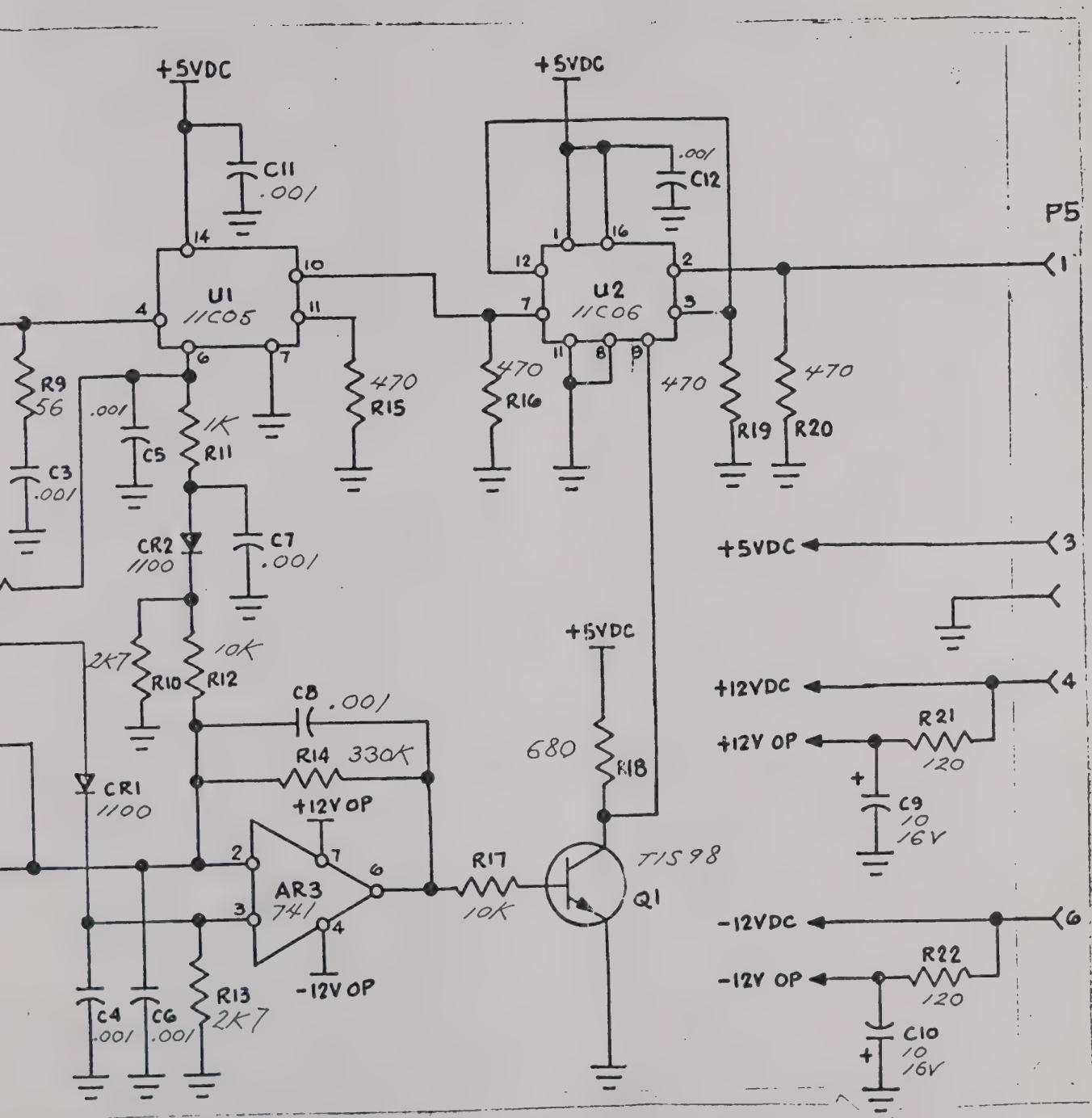
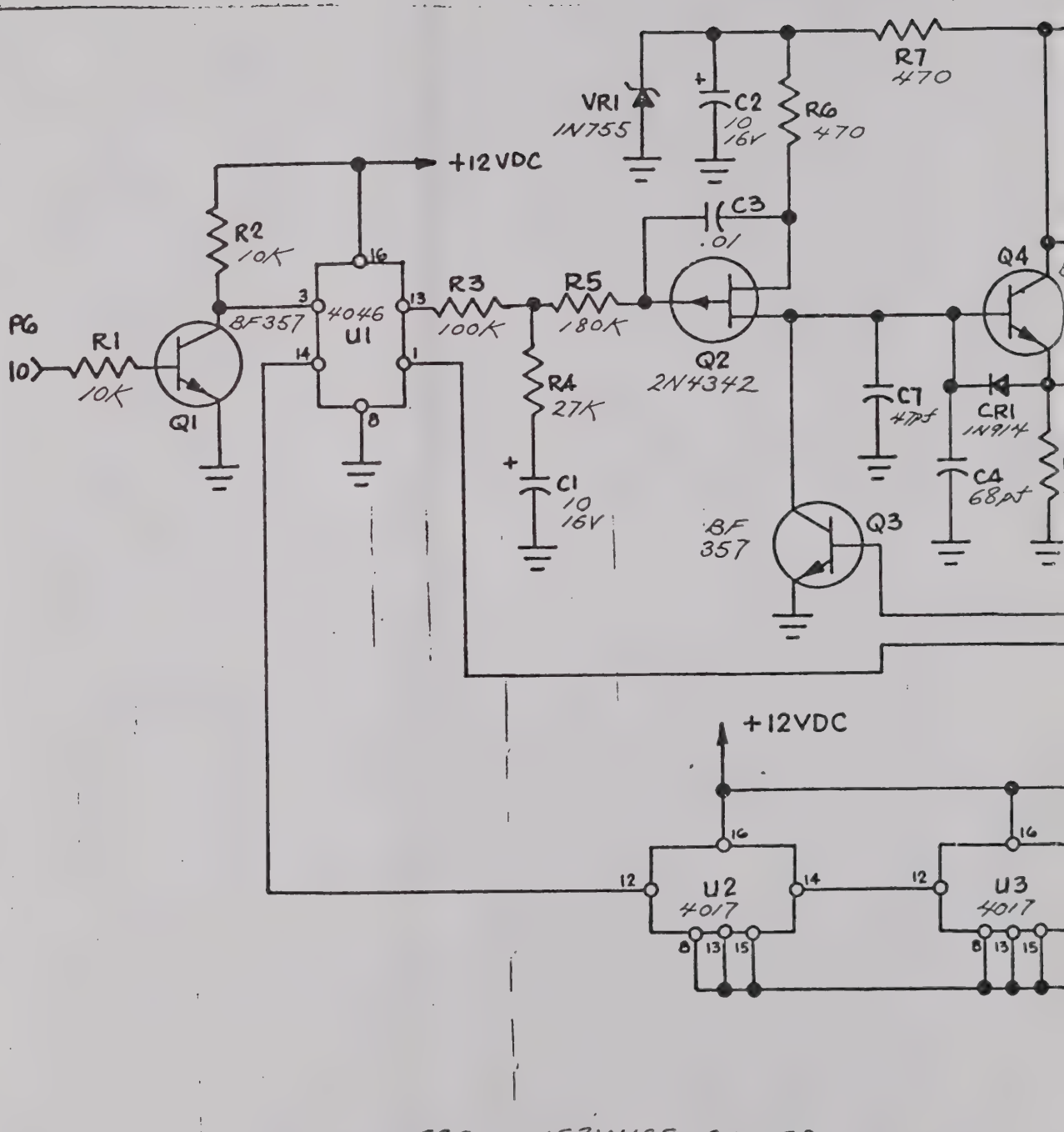


FIGURE 6-8
1000/1250 MHZ PRESCALER
4900A/4950A PCB SCHEMATIC



UNLESS OTHERWISE STATED
RESISTORS IN OHMS, 5%, 1/4W
CAPACITORS IN MICROFARADS.

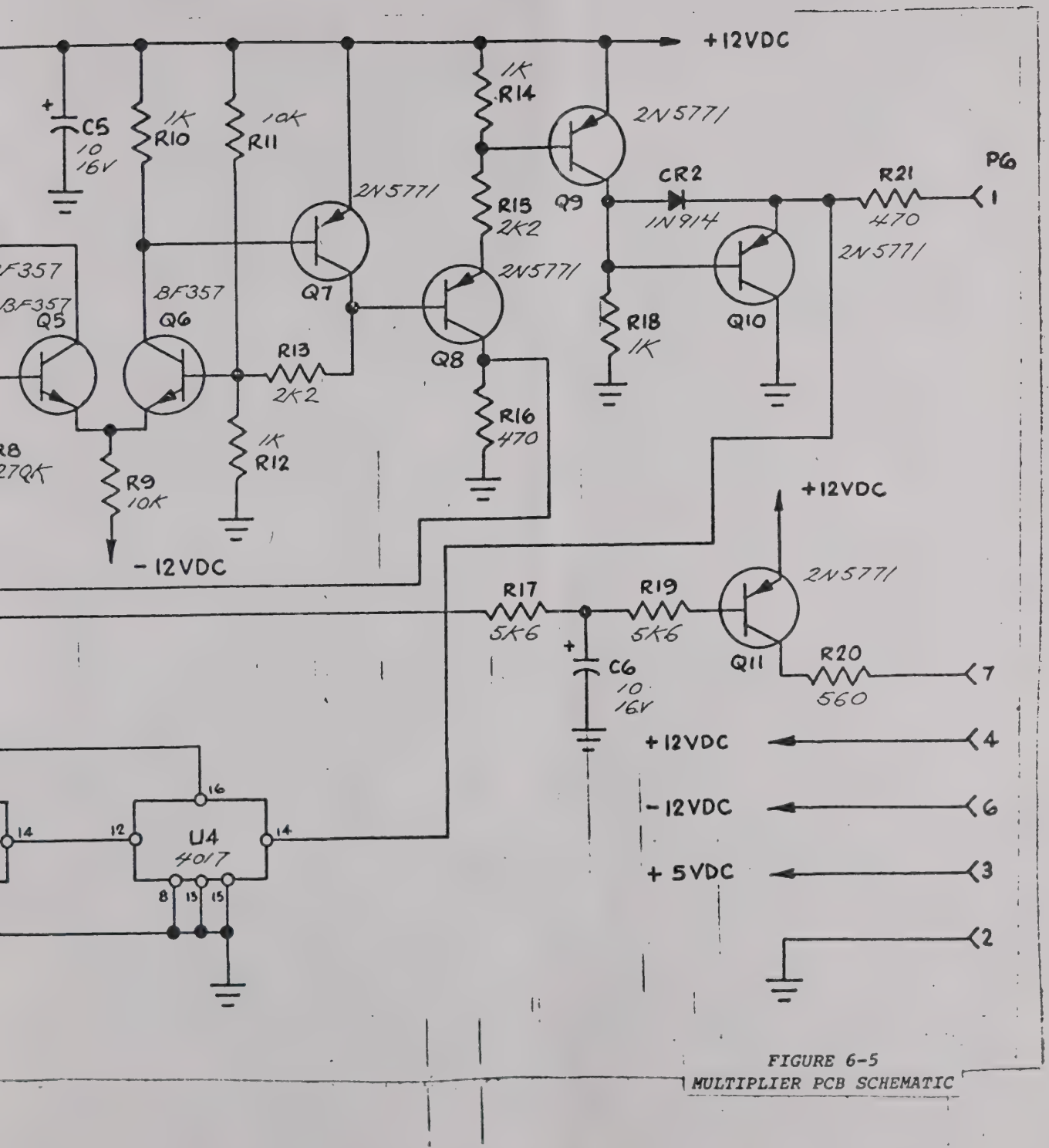
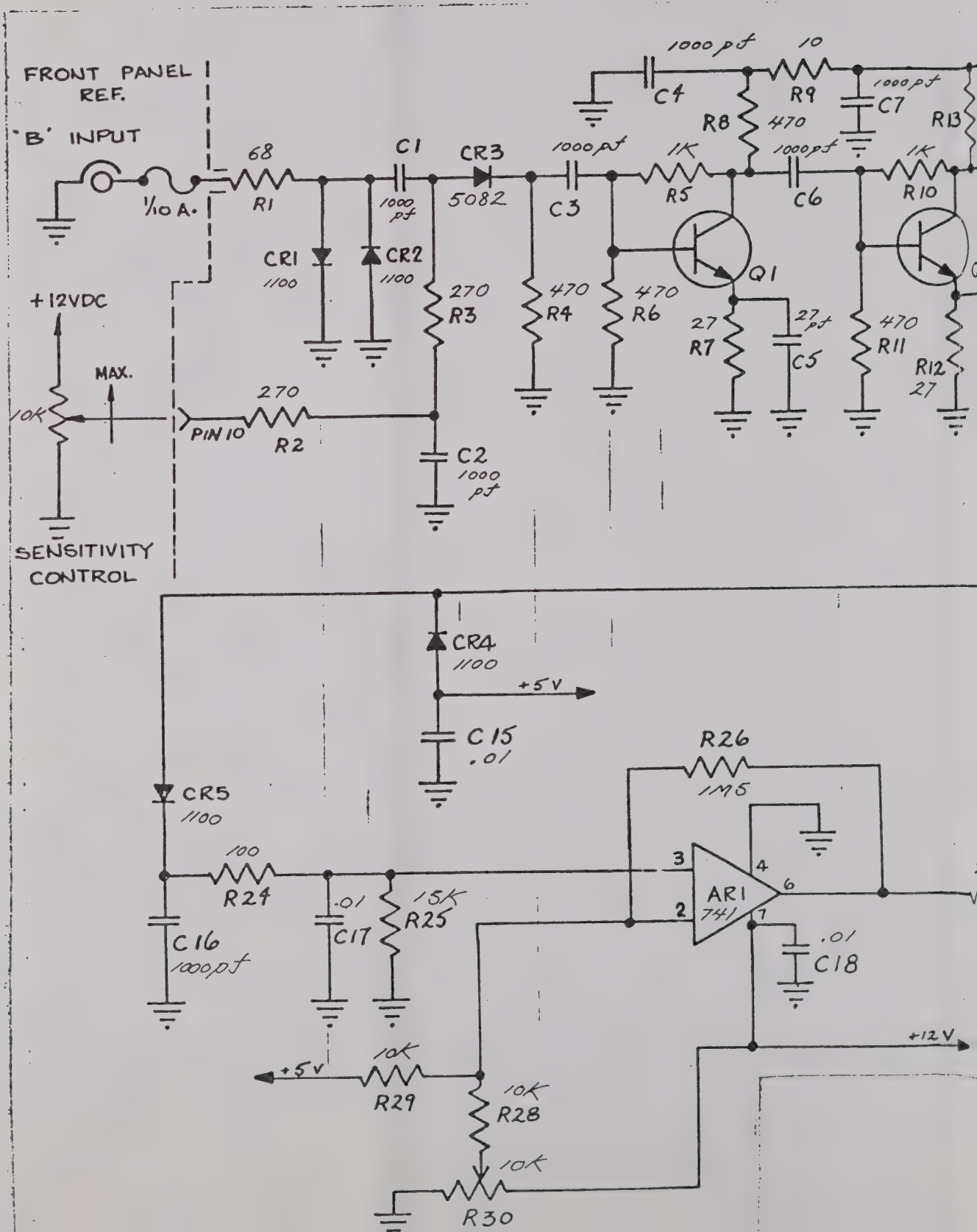


FIGURE 6-5
MULTIPLIER PCB SCHEMATIC


FRONT PANEL REF.
'B' INPUT
1/10 A.
68
R1
C1
1000 pf
CR3
5082
1000pf
C3
1K
R5
1000 pf
C4
10
R9
1000pf
C7
R8
470
1000pf
C6
R13
1K
R10
CR1
1100
CR2
1100
270
R3
470
R4
470
R6
Q1
27
R7
27pf
C5
470
R11
R12
27
+12VDC
MAX.
10K
270
PIN 10
R2
C2
1000 pf
SENSITIVITY CONTROL
CR4
1100
+5V
C15
.01
R26
1M5
CR5
1100
100
R24
C16
1000pf
.01
C17
15K
R25
3
2
4
6
7
AR1
741
.01
C18
+12V
+5V
10K
R29
10K
R28
10K
R30

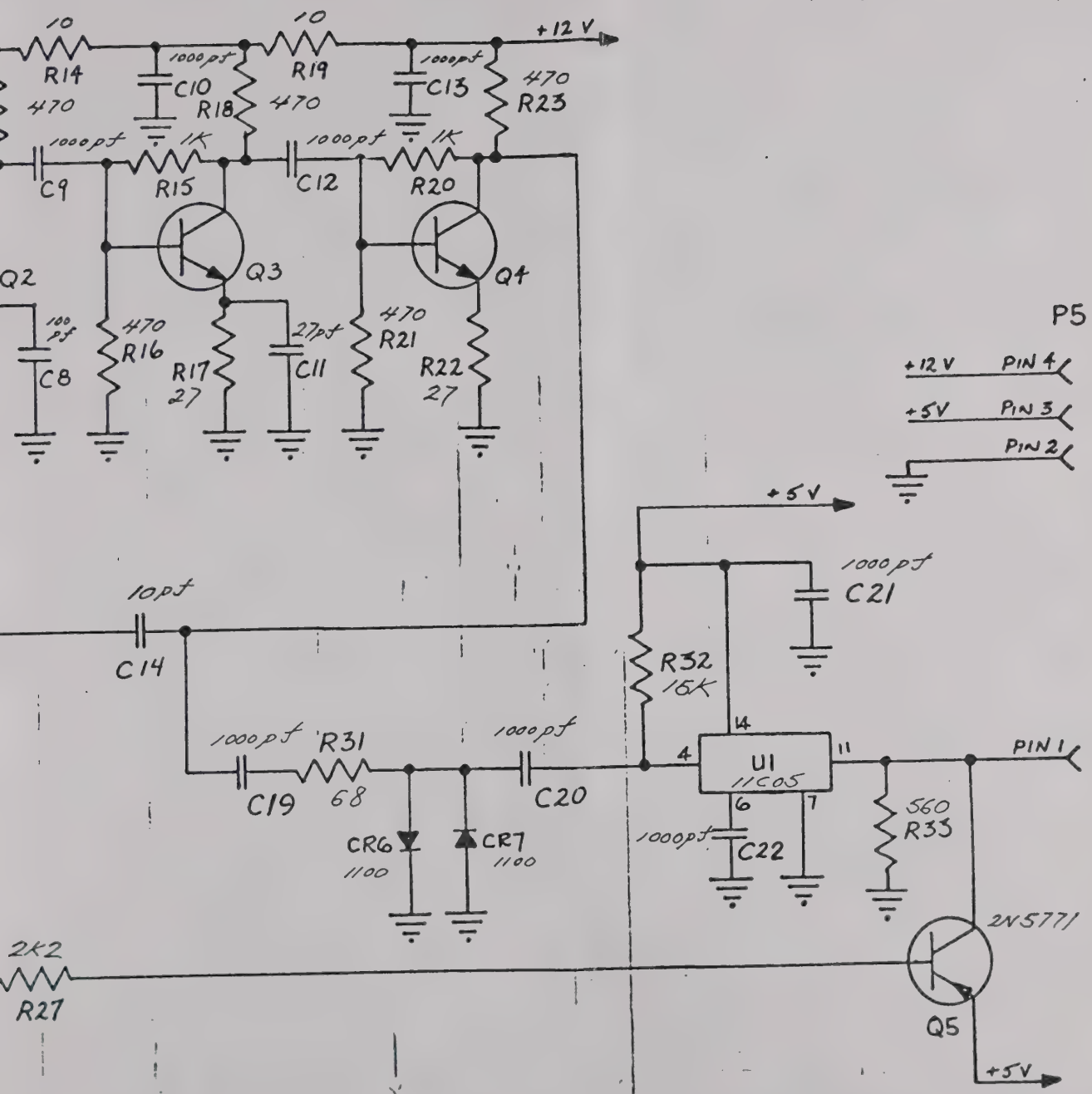
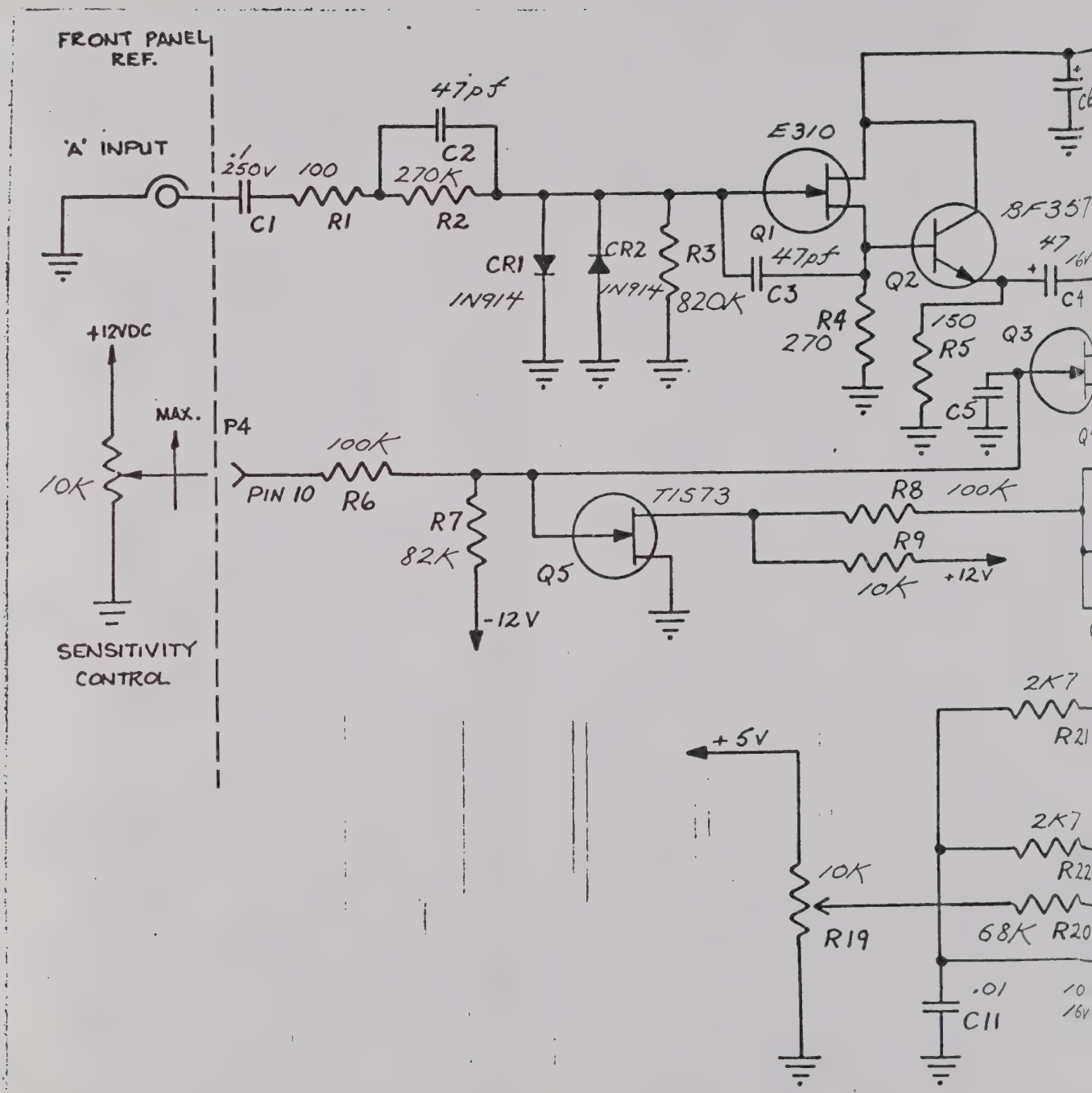


FIGURE 6-4
520 MHZ PRESCALER
4800A PCB SCHEMATIC

UNLESS OTHERWISE STATED
RESISTORS IN OHMS, 5%, 1/4W
CAPACITORS IN MICROFARADS



UNLESS OTHERWISE STATED
RESISTORS IN OHMS, 5%, 1/4 W.
CAPACITORS IN MICROFARADS

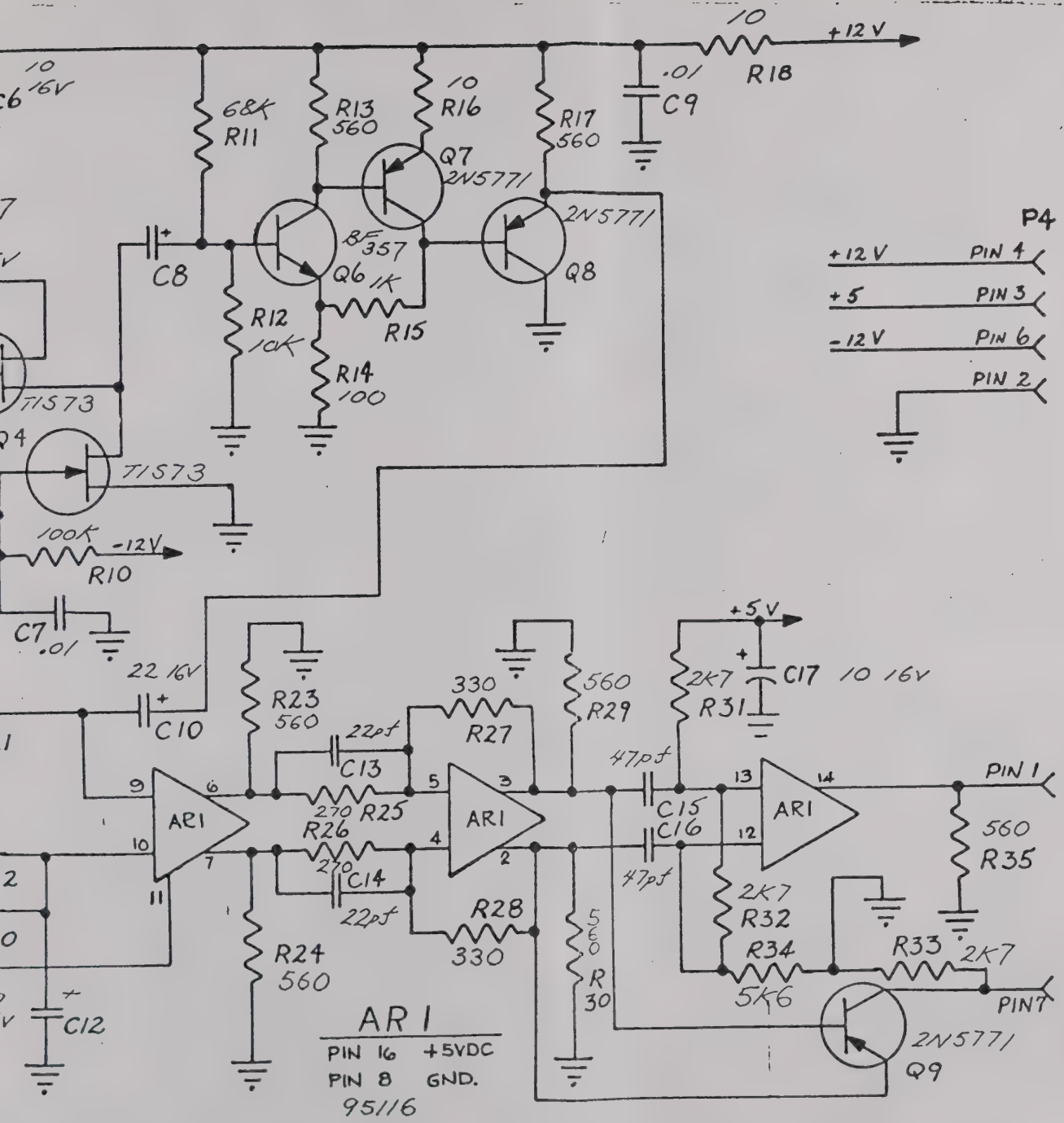
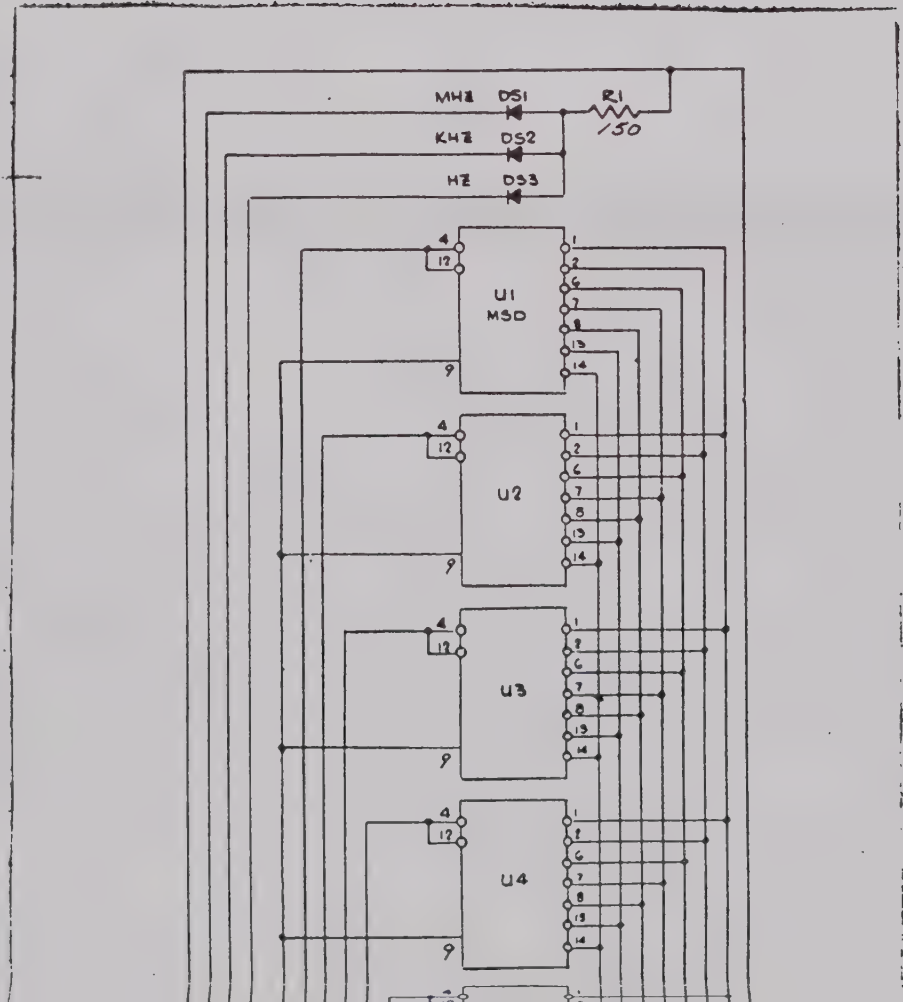


FIGURE 6-3
DIRECT AMPLIFIER PCB SCHEMATIC


MHZ
DS1
R1
150
KHZ
DS2
HZ
DS3
U1
MSD
U2
U3
U4
4
12
9
1
2
6
7
8
13
14

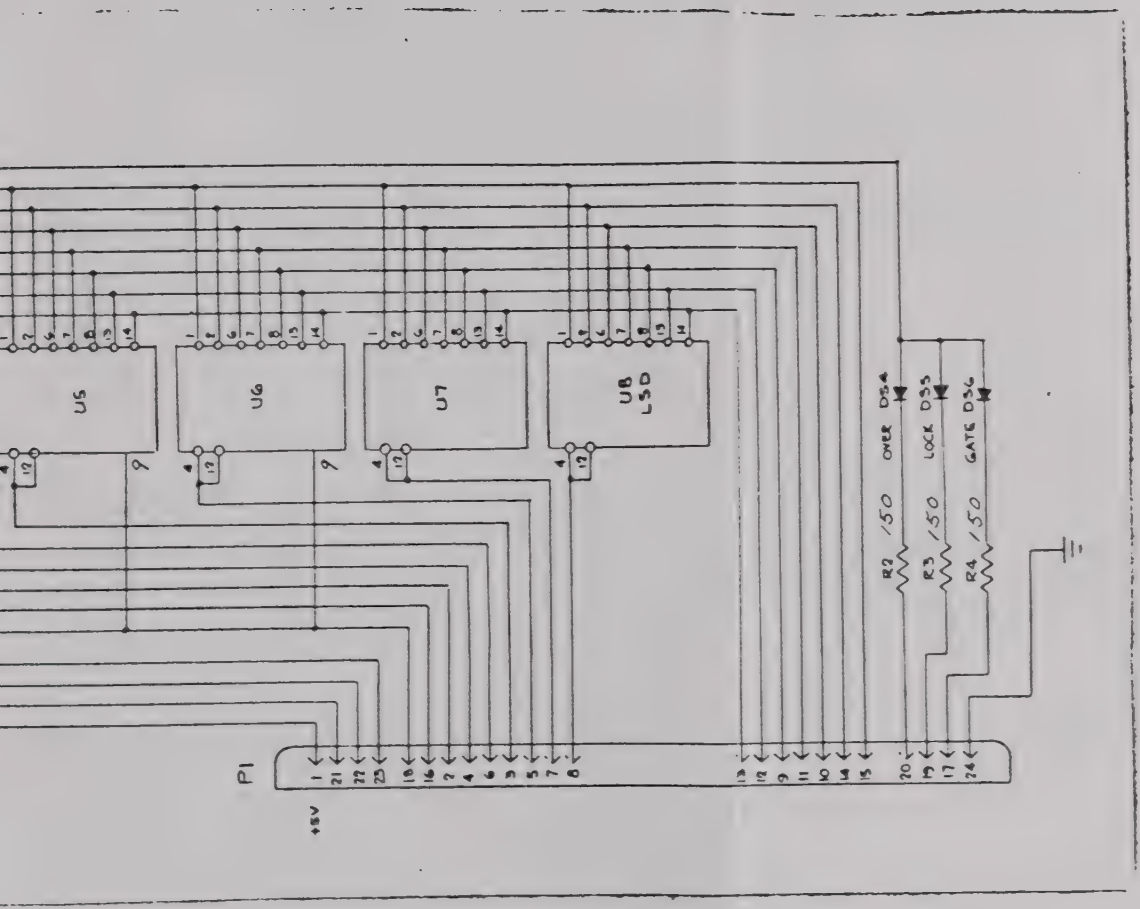
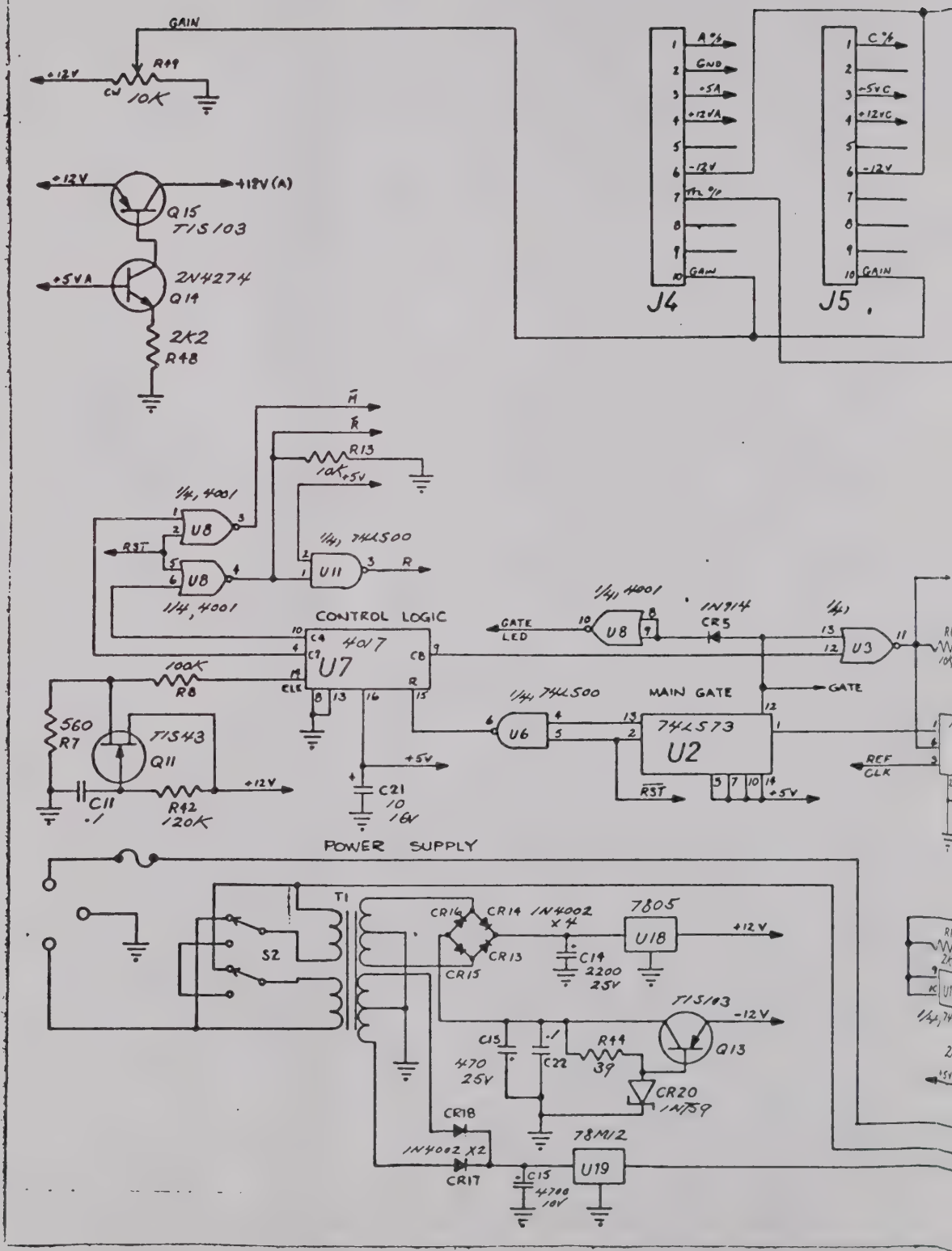
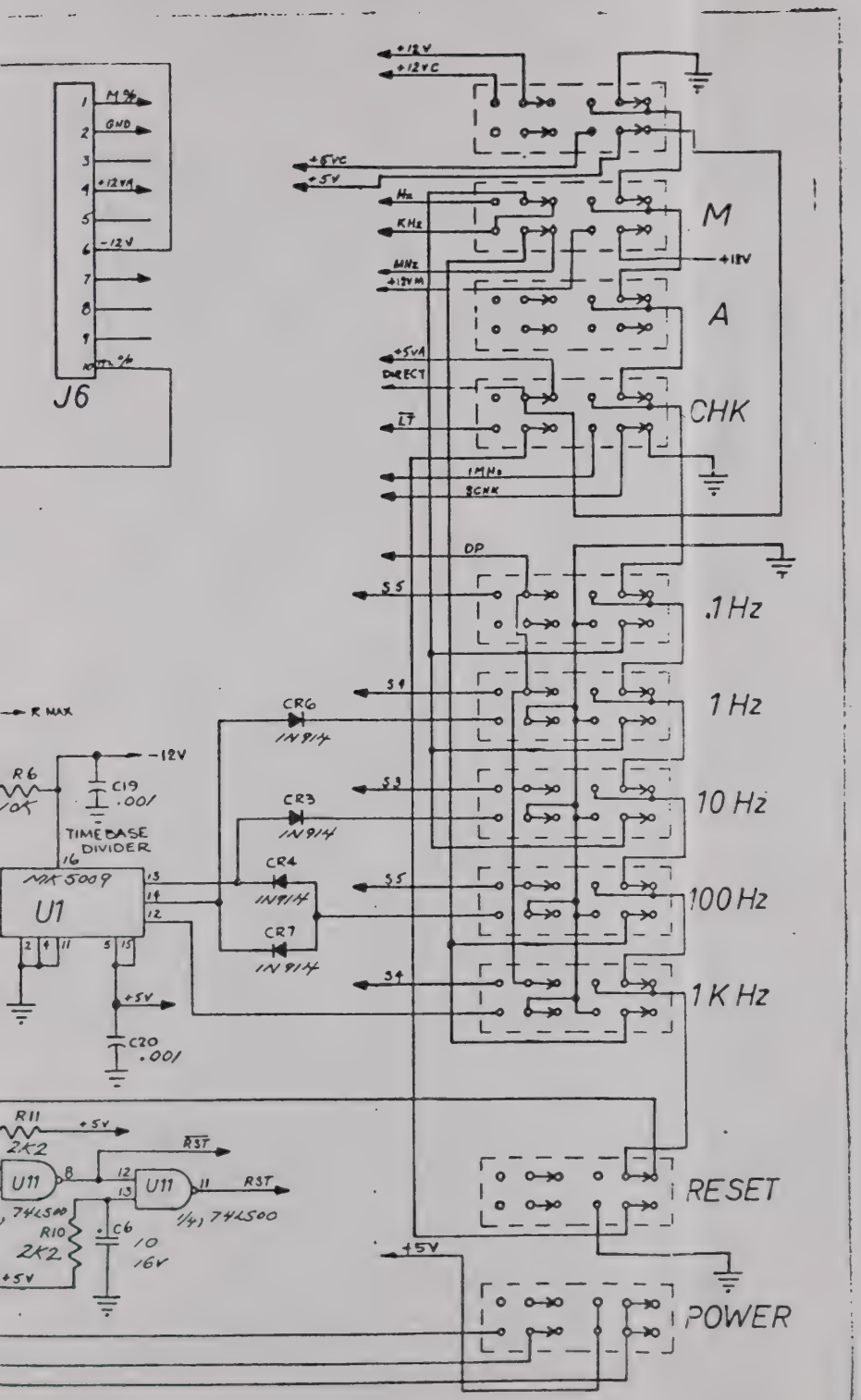
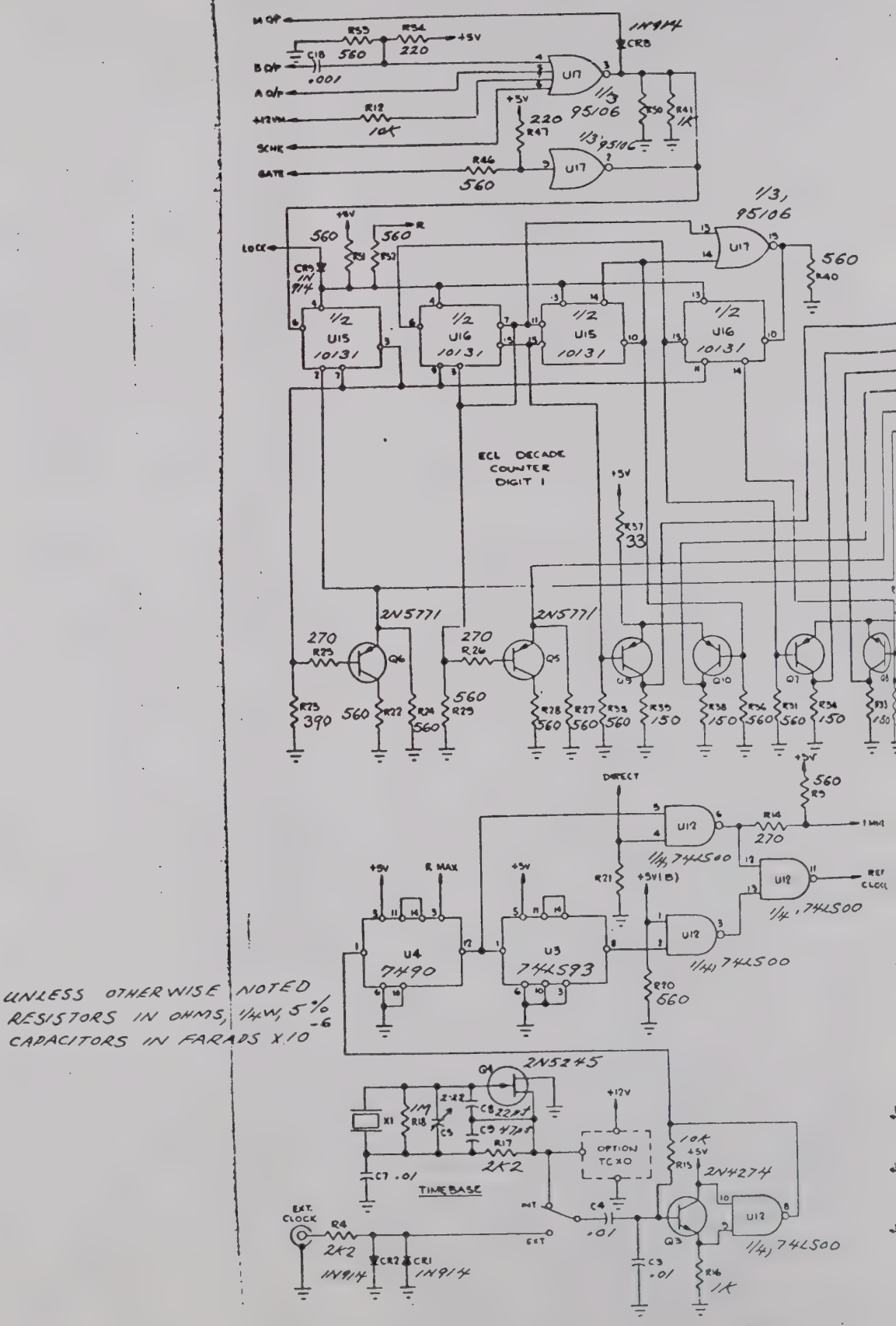


FIGURE 6-2
DISPLAY PCB SCHEMATIC


GAIN
+12V
R49
CW 10K
+12V
+12V (A)
Q15
TIS103
+5VA
2N4274
Q14
2K2
R48
J4
J5
A%
GND
+5A
+12VA
-12V
GAIN
C%
-5VC
+12VC
-12V
GAIN
H
K
R13
10K +5V
1/4, 4001
U8
RST
1/4, 74LS00
U11
R
1/4, 4001
U8
CONTROL LOGIC
4017
U7
100K
R8
560
R7
TIS43
Q11
C11
.1
R42
120K
+12V
+5V
C21
10
16V
1/4, 4001
GATE LED
U8
IN914
CR5
1/4
U3
GATE
1/4, 74LS00
U6
MAIN GATE
74LS73
U2
RST
+5V
GATE
REF CLK
POWER SUPPLY
T1
S2
CR16
CR14 IN4002 X4
CR13
CR15
7805
U18
+12V
C19
2200
25V
TIS103
-12V
Q13
C15
470
25V
C22
.1
R44
39
CR20
IN759
CR18
IN4002 X2
CR17
78M12
U19
C15
4700
10V



MAIN PCB SCHEMATIC
SHEET 2 OF 2


M O/P
B O/P
A O/P
+12V IN
SCHR
GATE
R33 560
R34 220
+5V
C18 .001
R12 10K
R47 220
R46 560
U17
1/3 95106
1N914
CR8
R50
R41 1K
LOCK
+5V
560
R
CR9 IN 914
R51
R52
U15 1/2 10131
U16 1/2 10131
U15 1/2 10131
U16 1/2 10131
U17 1/3, 95106
R40 560
ECL DECADE COUNTER DIGIT 1
+5V
R37 33
2N5771
270 R25
270 R26
Q6
Q5
Q9
Q10
Q7
Q8
R23 390
560 R22
R24 560
560 R29
R28 560
R27 560
R33 560
R35 150
R38 150
R24 560
R31 560
R34 150
R33 150
+5V
560 R9
DIRECT
U12
R14 270
1/4, 74LS00
1 MHz
+5V
R MAX
U4 7490
+5V
U3 74LS93
R21
+5V(B)
U12
1/4, 74LS00
REF CLOCK
R20 560
UNLESS OTHERWISE NOTED
RESISTORS IN OHMS, 1/4W, 5%
CAPACITORS IN FARADS X10
-6
Q4 2N5245
X1
1M R18
2-22 C8
C5
C9 47pF
R17 2K2
C7 .01
TIMEBASE
+12V
OPTION TCXO
10K R15
+5V
2N4274
Q3
C4 .01
INT
EXT
EXT. CLOCK
R4 2K2
CR2 IN914
CR1 IN914
C3 .01
R16 1K
U12
1/4, 74LS00

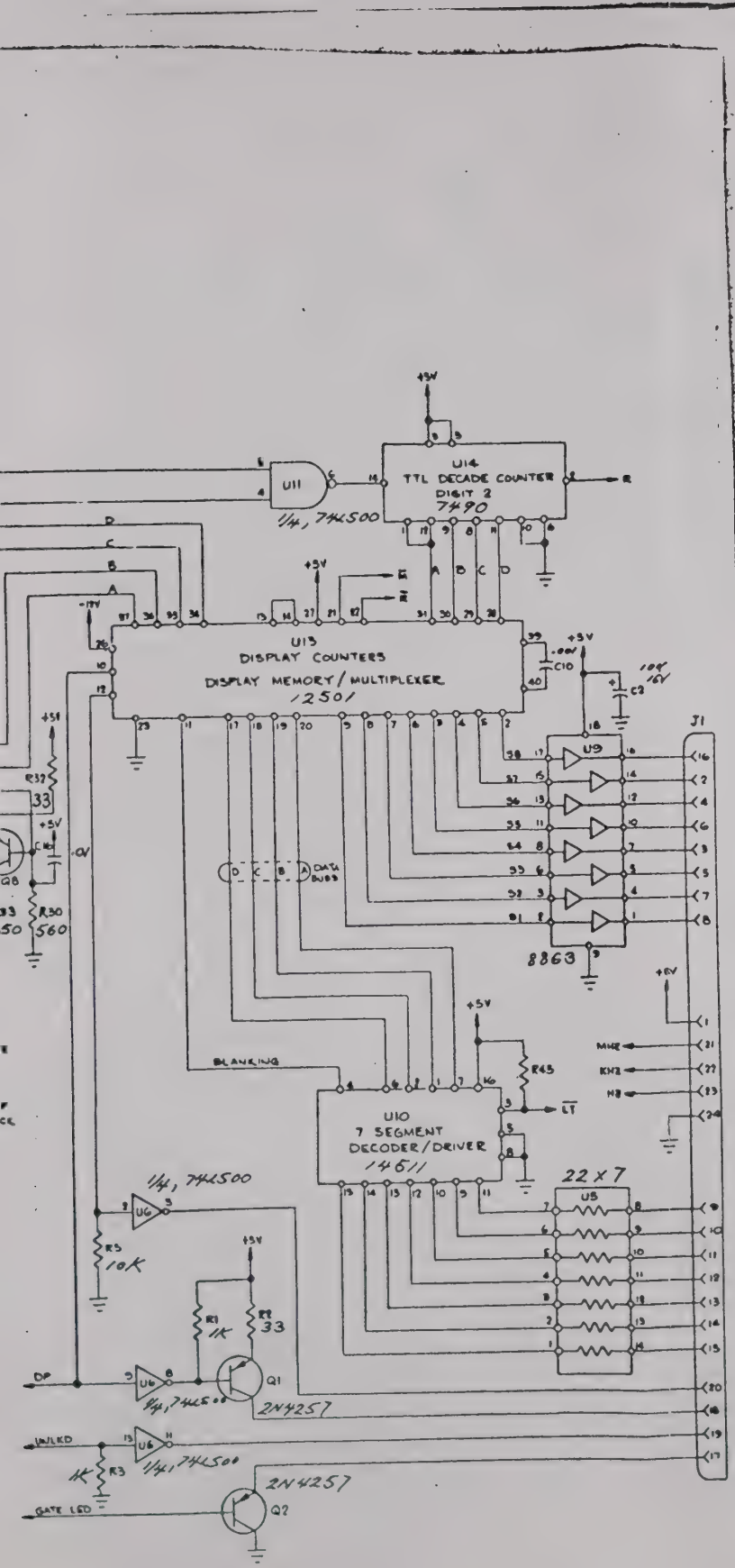


FIGURE 6-1
MAIN PCB SCHEMATIC
SHEET 1 OF 2

Section 6

Schematic Diagrams

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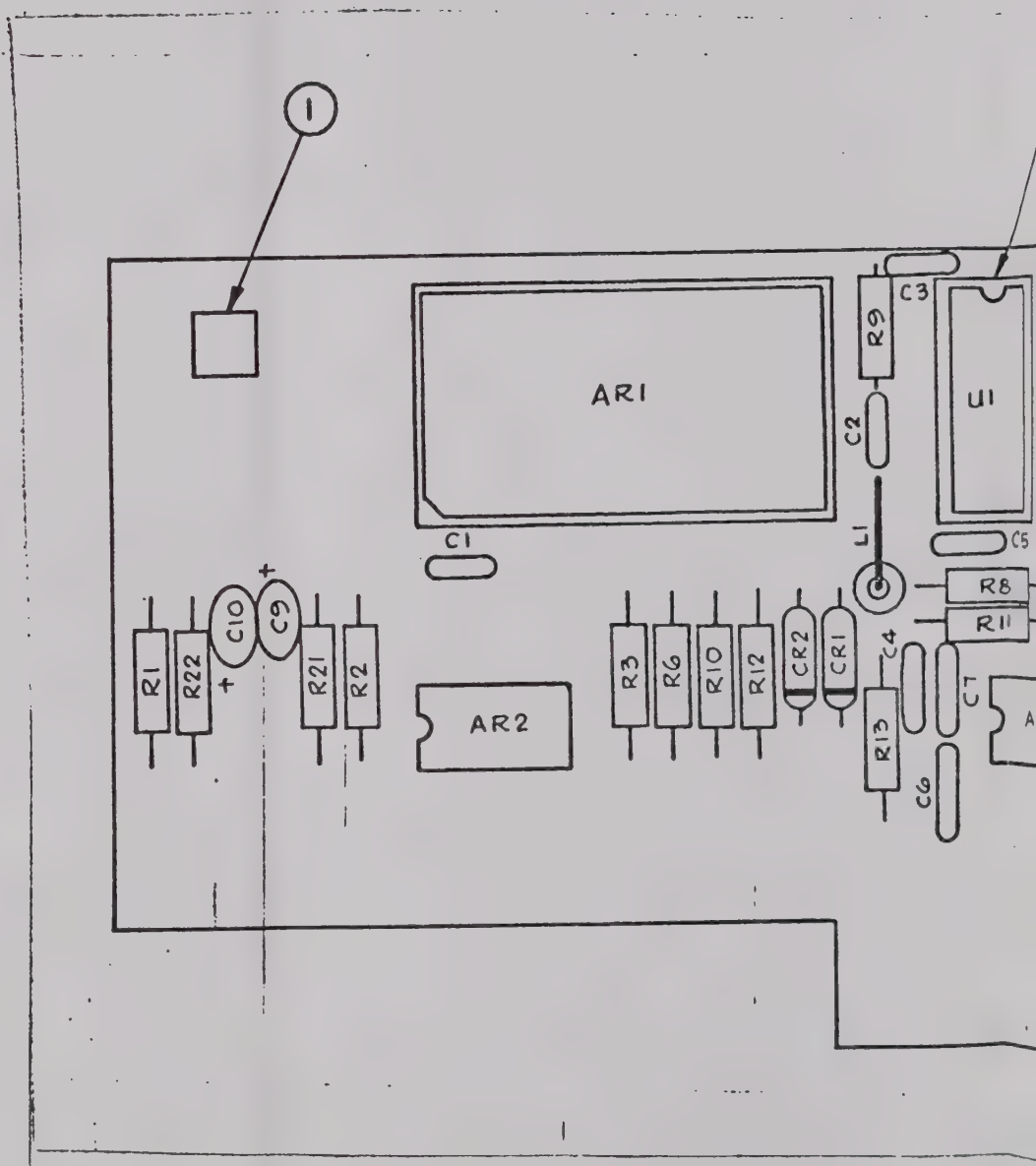
FIGURE 5-8
DATA OUTPUT PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	DATA OUTPUT UNIT PCB ASSEMBLY				
	TO BE SUPPLIED IN FINAL MANUAL				

TO BE SUPPLIED IN FINAL MANUAL

FIGURE 5-7
BATTERY PCI ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	BATTERY PCB ASSEMBLY				
	TO BE SUPPLIED IN FINAL MANUAL				


1
AR1
C3
R9
U1
C2
C1
L1
C5
R8
R11
C10
C9
R1
R22
R21
R2
AR2
R3
R6
R10
R12
CR2
CR1
C4
C7
R13
C6

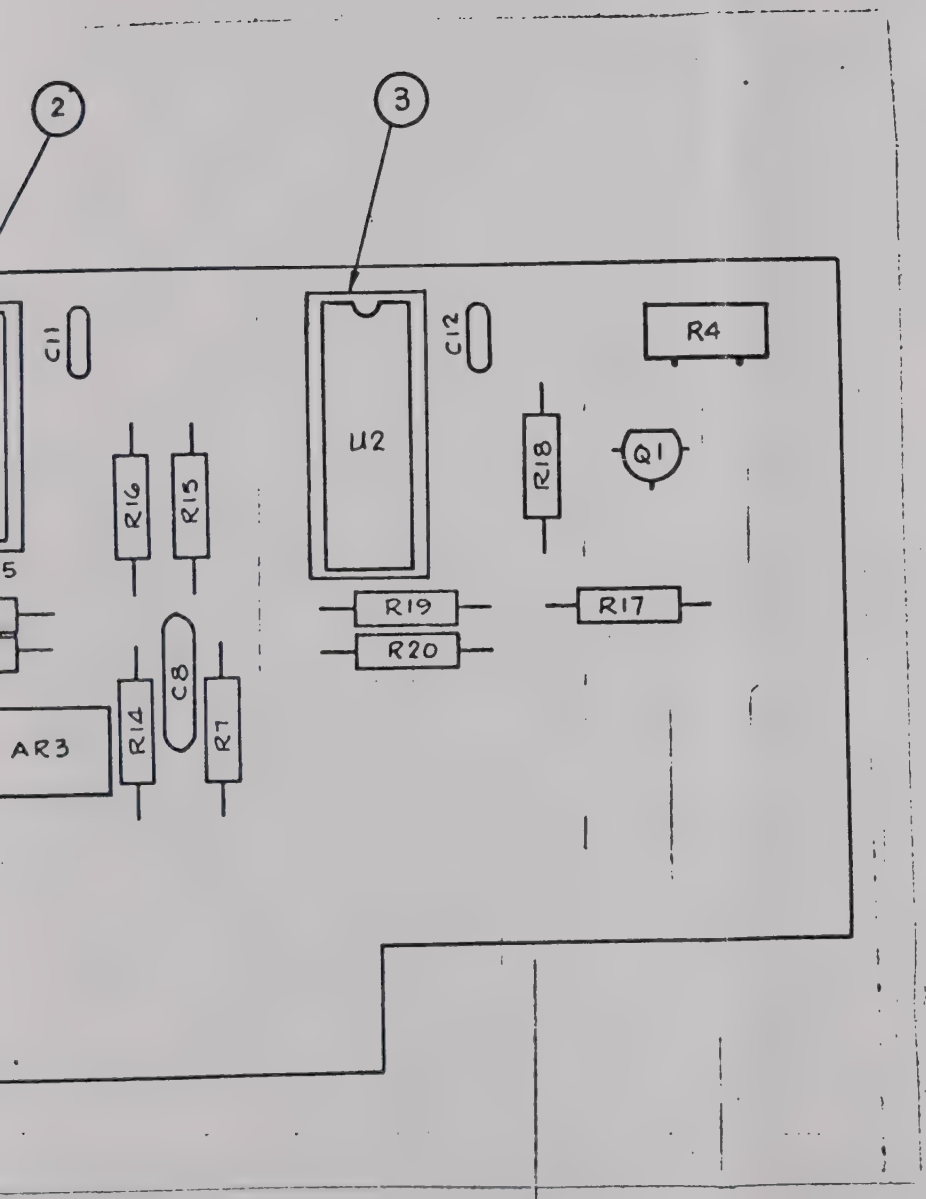
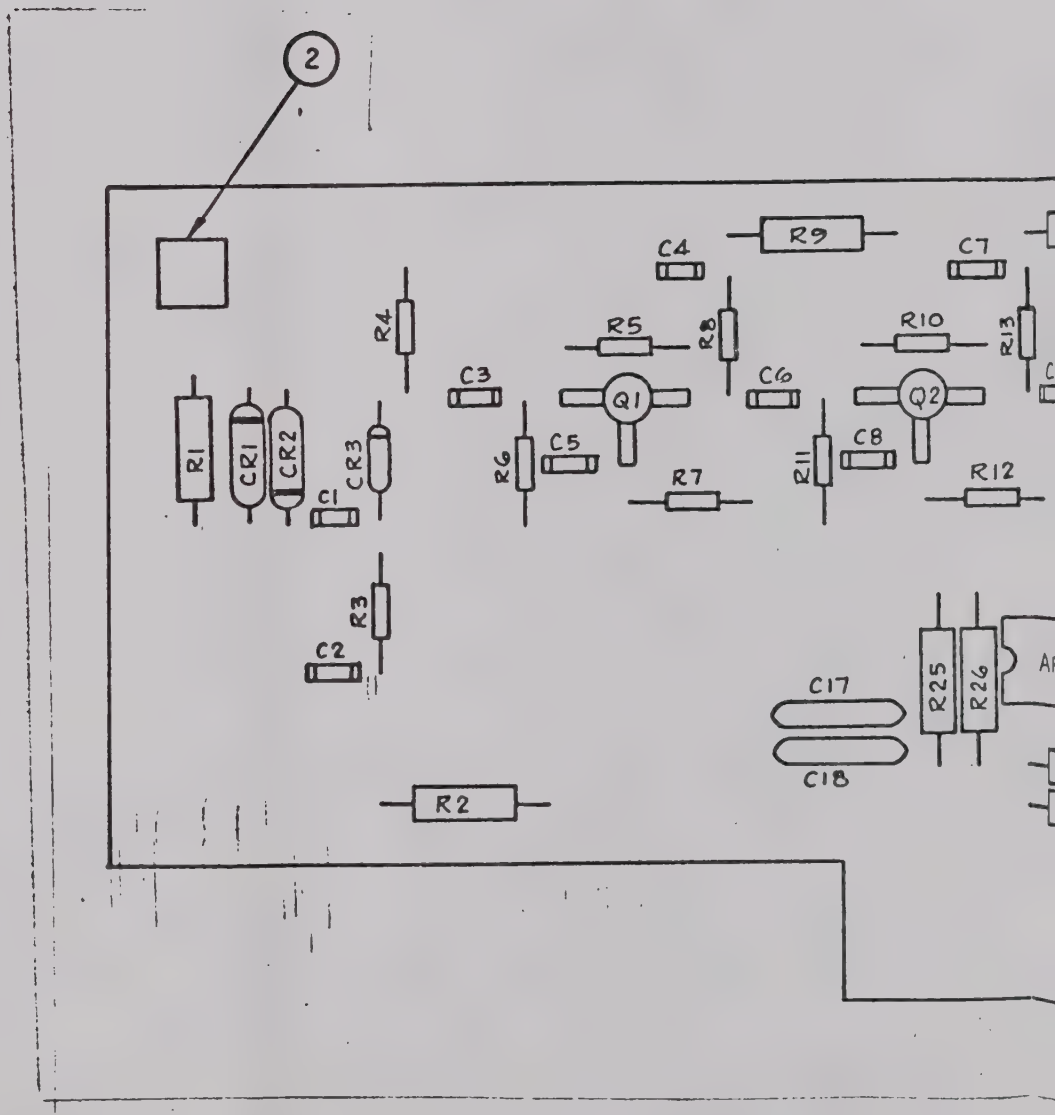


FIGURE 5-6
1000/1250 MHZ PRESCALER
4900A/4950A PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	1000 AND 1250 MHZ PRESCALER PCB ASSEMBLY (Cont'd)				
U1-A	IC., 11C05 (1 GHZ VERSION ONLY)	047105	07263	11C05	1
U1-B	IC., 11c05A (1.25 GHZ VERSION ONLY)	047105A			1
U2	IC., 11C06	047106	07263	11C06	1
AR1-A	AMPLIFIER, CA-1048 (1 GHZ VERSION ONLY)	047144			1
AR1-B	AMPLIFIER, CA-1048A (1.25GHZ VERSION ONLY)	047144A			1
1.	COAX CABLE ASSY	071610			1
2.	SOCKET, IC., 14 PIN, L.P.	061214	00779	583527-1	1
3.	SOCKET, IC., 16 PIN, L.P.	061216	00779	C931602	1

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	1000 MHZ PRESCALER PCB ASSEMBLY 4900A,	085496		085496	1
	1250 MHZ PRESCALER PCB ASSEMBLY 4950A	085495		085495	1
	Figure 5-6				
C1	CAP., 0.001UF	011120	71590		8
C2					
C3					
C4					
C5					
C6					
C7					
C12					
C8	CAP., CER. DISC., 0.001UF, 500V	011119	71590	CF102	1
C9	CAP., TA., 10UF, 16V, 20%	011201	56289		2
C10					
CR1	DIODE, HOT CARRIER, FH1100	031110	07263	FH1100	2
CR2					
Q1	TRANS., TIS98, NPN, SI, LOP	033204		TIS98	1
L1	INDUCTOR				
R1	RES., 1/4W, 5%, CC, 10K	022310	01121		4
R2					
R12					
R17					
R3	RES., 1/4W, 5%, CC, 4K7	022247	01121		1
R4	RES., TRIMPOT, 10K	027310	PIHER	PT-10H-10K	1
R6	RES., 1/4W, 5%, CC, 82K	022382	01121		2
R7					
R8	RES., 1/4W, 5%, CC, 1K	022210	01121		2
R11					
R10	RES., 1/4W, 5%, CC, 2K7	022227	01121		2
R13					
R14	RES., 1/4W 5%, CC, 330K	022333	01121		1
R15	RES., 1/4W 5%, CC, 470 OHMS	022147	01121		4
R16					
R19					
R20					
R 8	RES., 1/4W, 5%, CC, 680 OHMS	022168	01121		1
R?	RES., 1/4W, 5%, CC, 120 OHMS	022112	01121		2
R?					


2
R1
CR1
CR2
CR3
C1
R2
R3
C2
R4
C3
R5
R8
Q1
C4
R9
C7
R10
R13
C6
Q2
C8
R11
R12
R6
C5
R7
C17
C18
R25
R26

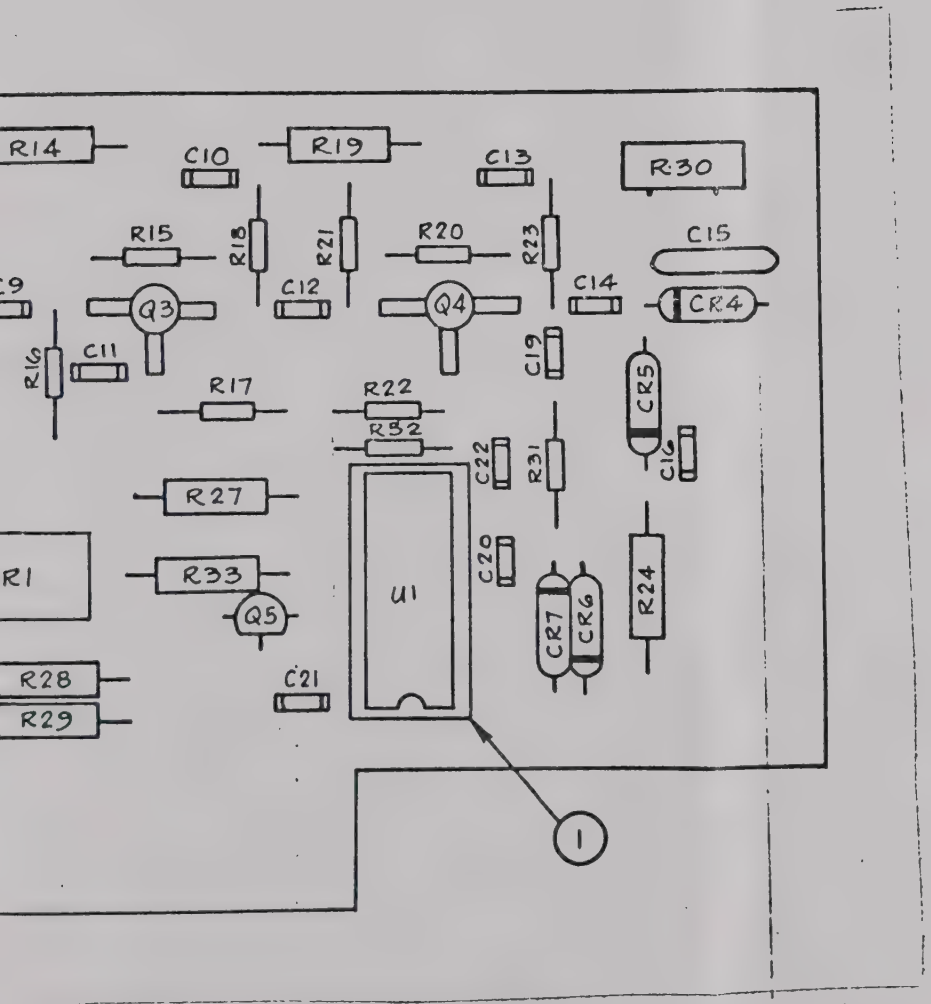
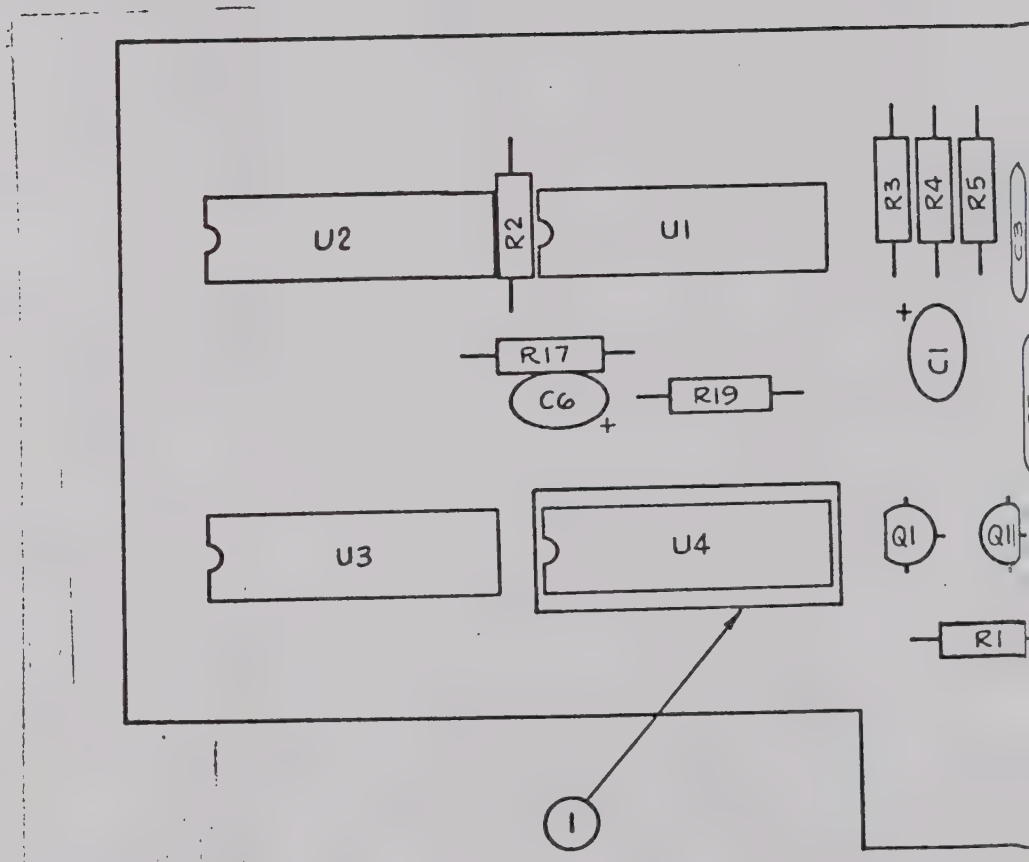


FIGURE 5-5
520 MHZ PRESCALER
4800A PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	520 MHZ PRESCALER PCB ASSEMBLY, 4800A (Cont'd)				
R10					
R15					
R20					
R7	RES., 1/8W, 10%, CC, 27 OHMS	021027			5
R12					
R17					
R22					
R31					
R9	RES., 1/4W, 5%, CC, 10 OHMS	022010	01121		3
R14					
R19					
R24	RES., 1/4W, 5%, CC, 100 OHMS	022110	01121		1
R25	RES., 1/4W, 5%, CC, 15K	022315	01121		1
R26	RES., 1/4W, 5%, CC, 1M5	022515	01121		1
R27	RES., 1/4W, 5%, CC, 2K2	022222	01121		1
R28	RES., 1/4W, 5%, CC, 10K	022310	01121		2
R29					
R30	RES., TRIMPOT, 10K	027310	PIHER	PT-10H-10K	1
R32	RES., 1/8W, 10%, CC, 15K	021315			1
R33	RES., 1/4W, 5%, CC, 560 OHMS	022156	01121		
Q1	TRANS., BFR90	033304	07263	BFR90	4
Q2					
Q3					
Q4					
Q5	TRANS., SI, PNP	033101	07263	2N5771	1
AR1	IC., 741 MINI DIP, OP AMP	047741	07263	741TC	1
U1	IC., 11C05	047105	07263	11C05	1
1.	SOCKET, IC., 14 PIN L.P.	061214	00779	583527-1	1
2.	COAX CABLE ASSY	071610			1

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	520 MHZ PRESCALER PCB ASSEMBLY, 4800A Figure 5-5	085483		05483	1
C1	CAP., CHIP, 1000PF	011118			15
C2					
C3					
C4					
C6					
C7					
C9					
C10					
C12					
C13					
C16					
C19					
C20					
C21					
C22					
C5	CAP., CHIP, 27PF	011107			2
C11					
C8	CAP., CHIP, 100PF	011112			1
C14	CAP., CHIP, 10PF	011102			1
C15	CAP., CER. DISC., 0.01UF, 25V	011125	32897	5835-000Y5U 103Z	3
C17					
C18					
CR1	DIODE, HOT CARRIER	031110	07263	FH1100	6
CR2					
CR4					
CR5					
CR6					
CR7					
CR3	DIODE, HP5082-3188	031111	28480	HP5082-3379	1
R1	RES., 1/4W, 5%, CC, 68 OHMS	022068	01121		1
R2	RES., 1/4W, 5%, CC, 270 OHMS	022127	01121		1
R3	RES., 1/8W, 10%, CC, 270 OHMS	021127			
R4	RES., 1/8W, 10%, CC, 470 OHMS	021147			9
R6					
R8					
R11					
R13					
R16					
R18					
R21					
R23					
R5	RES., 1/8W, 10%, CC, 1K	021210			4


U2
R2
U1
R3
R4
R5
C3
C1
R17
C6
R19
U3
U4
Q1
Q11
R1
1

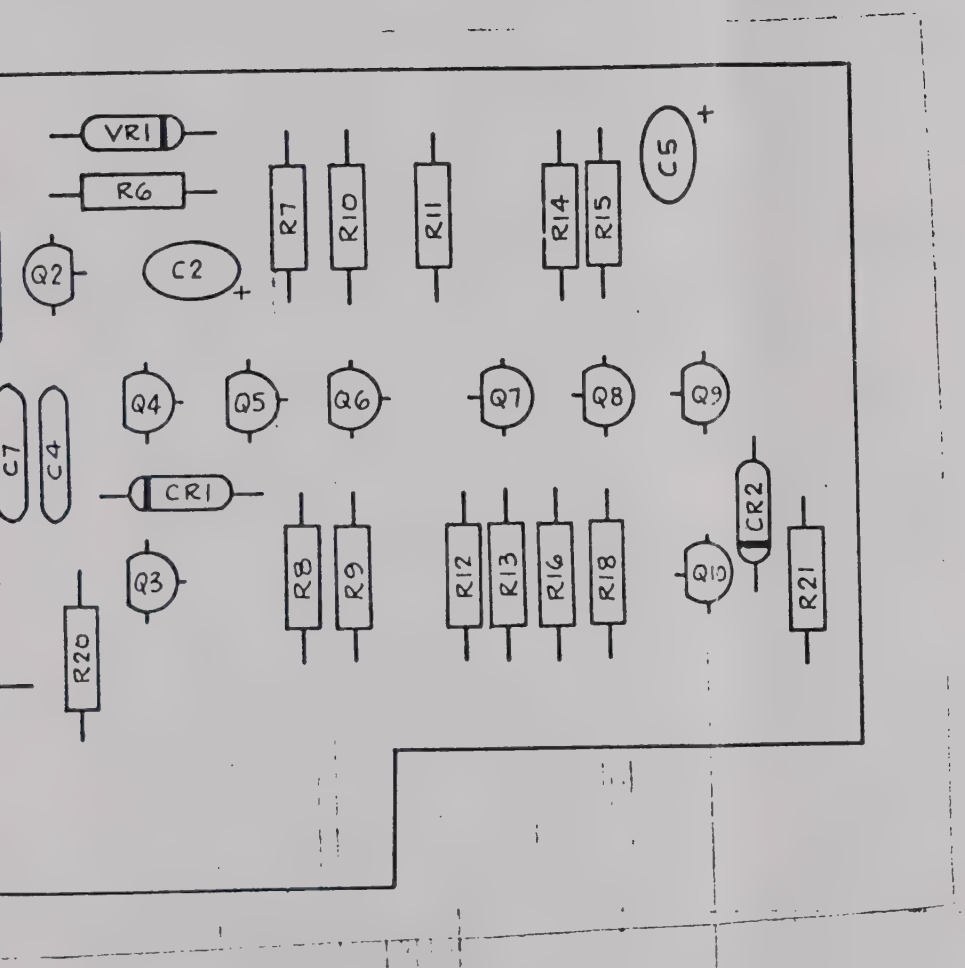


FIGURE 5-4
MULTIPLIER PCB ASSEMBLY

4-10 FUSE REPLACEMENT

4-11 The input power fuse, F1, is located on the rear panel of the unit. When replacement is required, install 500 mA AGC for 115 V, or 250 mA AGC for 230 V input.

4-12 The prescaler input fuse is located in the front panel mounted fuse holder. To gain access to the fuse, rotate the B Channel BNC connector counter-clockwise. Remove the damaged fuse using a pair of needle-nose pliers. Replacement and spare fuse elements are available from the factory. Specify Navtel P/N 062005 when ordering.

4-13 PERFORMANCE CHECKS

4-14 The performance checks provide a means of verifying overall operation. The checks can be used as an acceptance check during incoming inspection or as a periodic maintenance check. Refer to Table 4-1 for a list of required test equipment. Equivalent equipment may be used.

4-15 FUNCTIONAL CHECK

4-16 To perform a functional check, refer to the self-check described in paragraph 2-16.

4-17 SENSITIVITY CHECK CHANNEL A

4-18 Perform the checks as follows:

a. Connect the generator, set for 5 Hz at 15 mV rms to the Channel A input.

b. Rotate sensitivity control to MAX. and verify correct reading of 5 Hz ± generator instability.

c. Repeat b. at 100 Hz, 10 kHz, 1 MHz and 100 MHz.

d. Repeat b. at 125 MHz with input level of 25 mV rms.

4-19 SENSITIVITY CHECK CHANNEL B 4800A, 4900A, 4950A ONLY

4-20 Perform the sensitivity check as follows:

a. Connect the generator, set for 80 MHz at 15 mV rms to the counter input.

b. Rotate sensitivity control to MAX, and verify correct reading of 80 MHz ± generator instability.

c. Repeat b. approximately every 200 MHz to the upper limit of the Prescaler.

d. Up to 1000 MHz confirm that the sensitivity is less than 15 mV rms. From 1000 MHz to 1250 MHz confirm that the sensitivity is less than 50 mV rms.

4-21 ACCURACY CHECK

4-22 The accuracy is a function of ambient temperature, line voltage and time since calibration. For example, assume an ambient temperature of 25°C, line voltage ±10% and six months since last calibrated to 10.00 MHz ±1 Hz at 25°C. A 10.00 MHz frequency standard measured at 1 Hz resolution will read 10000.000 kHz ± 20 Hz maximum.

4-23 CALIBRATION

4-24 Calibration comprises adjustment of the internal time base, the trigger, and threshold levels of the direct amplifier and the low level sense of the prescalers. These adjustments should be made after any repairs to the corresponding area.

4-25 DIRECT AMPLIFIER TRIGGER LEVEL

4-26 Adjust the Trigger as follows:

a. Set FREQUENCY to 5 Hz - 125 MHz and RESOLUTION to 1 kHz.

b. Connect high frequency signal generator and RMS voltmeter terminated by a 50 ohm load to 5 Hz - 125 MHz input.

c. Set generator to 125 MHz at 25 mV (rms), sensitivity control to MAX.

d. Adjust TRIGGER potentiometer R19 to a midpoint which produces a stable and correct display.

e. Reduce input level until display becomes unstable.

f. Readjust TRIGGER level for a stable display.

g. Repeat e. and f. until no additional increase in sensitivity is possible.

4-27 520 MHz PRESCALER 4800A LOW LEVEL SENSE ADJUSTMENT

4-28 To adjust low level sense proceed as follows:

a. Connect a high frequency generator and AC RMS voltmeter with high impedance probe to the Channel B input.

b. Rotate sensitivity control to MAX position.

c. Set trimpot R30 to maximum clockwise postion.

d. Set input frequency to 520 MHz at 15 mV rms.

e. Reduce input level until display becomes unstable.

f. Advance R30 slowly counter-clockwise until display reads zero.

g. Slowly increase input level until display again reads input frequency.

h. Input level should be less than 15 mV rms, if not return to step e.

4-29 *1000 MHZ AND 1250 MHZ PRESCALER 4900A AND 4950A LOW LEVEL SENSE ADJUSTMENT*

4-30 *To adjust low level sense proceed as follows:*

a. *Connect a high frequency generator and AC RMS voltmeter with high impedance probe to the Channel B input.*

b. *Rotate sensitivity control to MAX position.*

c. *Set trimpot R4 to maximum counter-clockwise position.*

d. *Set input frequency to 1000 MHz at 15 mV rms.*

e. *Reduce input level until display becomes unstable.*

f. *Advance R4 slowly clockwise until display reads zero.*

g. *Slowly increase input level until display again reads input frequency.*

h. *Input level should be less than 15 mV rms, if not return to step e.*

4-31 *TIME BASE OSCILLATOR ADJUSTMENT*

4-32 *Time base oscillator adjustment should be made whenever the counter is repaired, or whenever it is determined that accuracy of the counter is not within the accuracy desired. Perform time base oscillator adjustment in an environment having an ambient temperature of +22°C to +25°C (72°F to 77°F).*

4-33 *The time base oscillator output frequency can be accurately set using either of the two methods given. The first method, using a frequency standard for the reference, should be used whenever a standard is available. The second method uses the WWV broadcast frequency as the calibration standard, and may be used whenever a more suitable frequency standard is not available.*

4-34 *TIME BASE ADJUSTMENT USING A FREQUENCY STANDARD*

a. *Energize the counter and allow it to warm-up for one hour.*

b. *Connect the 10 MHz frequency standard to Input A.*

c. *On the counter, select the 1 Hz resolution.*

d. *While observing the display, adjust the clock ADJ capacitor (accessed through the rear panel) to obtain a reading of 10000.000 ± 1 digit.*

4-35 *TIME BASE ADJUSTMENT USING WWV*

4-36 This procedure requires the counter to be in close proximity to the receiver antenna lead-in cable.

a. Allow unit to warm-up for one hour.

b. Remove the top cover of the counter

c. Tune the SW receiver to the 10 MHz WWV broadcast.

d. Bring the counter near enough to the SW receiver antenna lead so that a zero beat note can be heard on the receiver's speaker. If insufficient radiation is picked up from the counter, turn the time base oscillator towards the antenna and move it in close.

e. Adjust the clock ADJ capacitor (accessed through the rear panel) for a "zero beat" on the receiver.

f. Observe the receiver signal level meter, and adjust for an exact null. This will put the time base oscillator output frequency within 1 Hz of the 10 MHz requirement.

4-37 TROUBLESHOOTING

4-38 The following information is designed to aid in trouble-shooting 4000 Series counters. Fault isolation is achieved by executing the self-check described in Section 2 and noting failure symptoms. The lists in paragraphs 4-40 and 4-41 describe several symptoms and the possible causes. Use these lists as troubleshooting guides in connunction with the theory of operation in Section 3.

4-39 Provision is made to check all segments of all LED's for the purpose of determining whether or not a dark segment(s) is due to a faulty LED or other circuitry. To light all segments of all LED's select the self-check function and depress RESET switch. All segments should light.

4-40 DISPLAY PROBLEMS

a. Perform self check using 1 Hz resolution.

b. Is gate lamp flashing at approximately 1 Hz? If not, check output of +12 V, +5 V, -12 V power supplies. Gate LED driver Q2.

c. Does display give correct indication of 1000.000 kHz? If not, check INT/EXT clock switch, time base and time base dividers.

d. Depress reset switch.

e. Are all digits dark? If not, check corresponding strobe signal from U13 to U9 to display.

f. Is a dark segment common to all digits? Check data bus from U13 to U10 and seven segment output of U10.

g. Is 100 kHz present on Pin 39 of U13? If not, check U13.

h. Is Pin 9 of U13 pulsing between 0 V and 5 V? If not, check U13.

i. Is Pin 4 of U10 pulsing between 0 V and 5 V? If not, check U13. If pulse is there, check U10.

4-41 DECIMAL PROBLEMS

a. Perform check through all resolution ranges.

b. Is decimal missing from all LED's? If not, replace faulty LED.

c. Is decimal missing from all LED's, check Q1, U6 and U13.

4-42 INTEGRATED CIRCUIT REPLACEMENT - CMOS AND PMOS TYPES

4-43 Table 4-2 lists the MOS types of integrated circuits used in the 4000 Series, for reference during repair. CMOS and PMOS integrated circuits can be destroyed by electrostatic discharge resulting from careless handling. During any repair or replacement procedure involving the handling of these types of integrated circuits, observe the following precautions to prevent damage.

a. CMOS and PMOS integrated circuits are supplied packed in conductive foam. Do not remove the conductive foam from the integrated circuit until ready for installation.

b. Ensure that the repairing personnel and the unit under repair are commonly grounded.

c. Ensure that the soldering iron used is grounded to the common ground.

TABLE 4-2 MOS - TYPE INTEGRATED CIRCUITS

REFERENCE DESIGNATOR		TYPE
Multiplier PCB	U1	CD4046
Multiplier PCB	U2, U3, U4	CD4017
Main PCB	U13	2501
Main PCB	U10	14511
Main PCB	U1	MK5009
Main PCB	U7	CD4017
Main PCB	U8	CD4001

Section 5

Lists of Replaceable Parts

ASSEMBLY NOMENCLATURE	PART NO.	PAGE
Display PCB Assembly	085467	5-3
Main PCB Assembly	085461	5-5
Main PCB Assembly 4950A	085495	5-5
Direct Amplifier PCB Assembly	085462	5-10
Multiplier PCB Assembly	085464	5-13
520 MHz Prescaler 4800A PCB Assembly	085483	5-16
1000 MHz Prescaler 4900A PCB Assembly	085496	5-19
1250 MHz Prescaler 4950A	085495	5-19
Battery PCB Assembly	-	5-22
Data Output Unit PCB Assembly	-	5-25

FEDERAL SUPPLY CODE

TABLE 5-1A.

00779	Amp Inc.,
01121	Allen Bradley
01295	Texas Instruments
04713	Motorola
07263	Fairchild
017856	Siliconix
25403	Amperex
27014	National
28480	Hewlett Packard
32897	Erie Technological
56289	Sprague
71450	CTS Corp.
71590	Centralab
73445	Amperex
95303	Radio Corp. of America
99392	STM Inc.,

5-1 INTRODUCTION

5-2 This section contains an illustrated parts breakdown of the instrument. Components are listed alpha-numerically by assembly. Electrical components are listed by reference designation and mechanical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3 PARTS LISTS INCLUDE THE FOLLOWING INFORMATION:

a. Reference Designation or Item Number.

b. Description of each part.

c. Stock Number.

d. Federal Supply Code for Manufacturers.

e. Manufacturer's Part Number or Type.

f. Total Quantity per assembly or component.

5-4 HOW TO OBTAIN PARTS

5-5 Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the factory by using the Stock Number. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6 To ensure prompt and efficient handling of your order, include the following information:

a. Quantity

b. Stock Number

c. Description

d. Reference Designation or Item Number

e. Printed Circuit Board Part Number

f. Instrument model and serial number

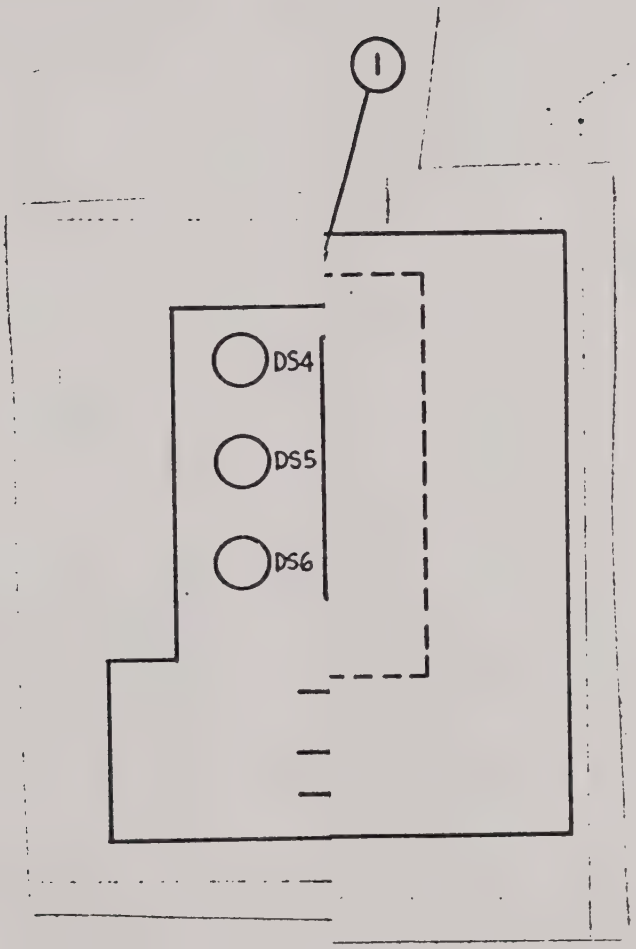


FIGURE 5-1
DISPLAY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	MAIN PCB ASSEMBLY	085495		085495	1
	MAIN PCB ASSEMBLY	085461		085461	1
	Figure 5-1				
C1	CAP. CER. DISC., 0.01UF, 20%	011125	32897	5835-000Y5U 103Z	8
C3					
C4					
C7					
C16					
C17					
C19					
C20					
C2	CAP. TA., 10UF, 20%, 16V	011201	56289	196D106X0015 JA1	3
C6					
C21					
C5	CAP. VAR., 7-25PF	013103			1
C8	CAP. CER. DISC., 22PF, 20%	011106	32897	831-000C0G022 0	1
C9	CAP. CER. DISC., 47PF, 20%	011108	56289	C030B102H470 5	2
C10					
C11	CAP. CER. DISC., 0.1UF, 25V	011128			1
C13	CAP. ELECT., 470UF, 25V	012111	25403	ET471X025A01	1
C14	CAP. ELECT., 2200UF, 25V	012114			1
C15	CAP. ELECT., 4700UF, 10V	012117	99392	39Cs15HL53	1
C18	CAP. CER. DISC., 0.001UF, 10%	011119	71590	CF102	1
C22	CAP. CER. DISC., 0.1UF, 25V	011128			
CR1	DIODE, ULTRA FAST SWITCH, SI.	031914	07263	1N914	9
CR9					
CR10	NOT USED				
CR11	NOT USED				
CR13	DIODE, SI, RECT.	031402	07163	1N4002	6
CR18					
CR19	DIODE, VOLTAGE REG., SI.	031759	07163	1N759A	1
Q1	TRANS., 2N4257, PNP, SI, LOP	033103	07263	2N4257	2
Q2					
Q3	TRANS., 2N4274, NPN, SI, LOP	033102	07263	2N4274	2
Q14					
Q4	TRANS., 2N5245, FET-N	033106	07263	2N4274	1
Q5	TRANS., 2N5771, PNP	033101	07263	2N5771	6
Q10					
Q11	TRANS., PNP, SI.	033201	07263	TIS43	1
Q13	TRANS., PNP, SI.	033203	07263	TCS103	2
Q15					

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	MAIN PCB ASSEMBLY (Cont'd)				
R1	RES., 1/4W, 5%, CC, 1K	022210	01121		6
R3					
R16					
R41					
R45					
R58					
R2	RES., 1/4W, 5%, CC, 33 OHMS	022033	01121		4
R19					
R32					
R37					
R4	RES., 1/4W, 5%, CC, 2K2	022222	01121		4
R10					
R11					
R17					
R5	RES., 1/4W, 5%, CC, 10K	022310	01121		5
R6					
R12					
R13					
R15					
R7	RES., 1/4W, 5%, CC, 560 OHMS	022156	01121		19
R9					
R20					
R21					
R22					
R24					
R27					
R28					
R29					
R30					
R31					
R35					
R36					
R40					
R46					
R51					
R52					
R53					
R54					
R8	RES., 1/4W, CC, 100K	022410	01121		1
R14	RES., 1/4W, CC, 270 OHM	022127	01121		3
R25					
R26					
R18	RES., 1/4W, CC, 1M	022510	01121		1
R23	RES., 1/4W, CC, 39 OHMS	022139	01121		2
R44					
R33	RES., 1/4W, CC., 150 OHMS	022115	01121		4

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	MAIN PCB ASSEMBLY (Cont'd)				
R34					
R38					
R39					
R42	RES., 1/4W, CC, 120K	022312	01121		1
R47	RES., 1/4W, CC, 220 OHMS	022122	01121		1
R49	RES., VAR., 10K	028461	71450	S-9554	1
U1	IC., P-MOS	044509		MK5009	1
U2	IC., TTL, DUAL J-K FF SCHOTTKY	041973	04713	74LS73	1
U3	IC., TTL, BINARY CTR.	041493			
U4	IC., TTL, DECADE CTR.	041490	01295	SN7490	2
U14					
U5	IC., DIP RESISTOR 7 @ 27 OHMS (REPLACEABLE BY 7@27 OHMS RESISTORS, P/N 022027)	049027			1
U6	IC., TTL, QUAD.2-INPUT NAND GATES	041490	01295	SN74LS00N	3
U11					
U12					
U7	IC., COS, DECADE COUNTER	044017	RCA	CD4017AE	1
U8	IC., COS, QUAD.2-INPUT NOR GATES	044001	RCA	CD4001AE	1
U9	IC., MOS-TO-LED 8 DIGIT DRIVER	041863	27014	DM8863N	1
U10	IC., BCD TO 7 SEG. LATCH/DECODER/DRIVER	046511	04713	MC14511CP	1
U13	IC., DIGITAL, MOS	044501		LSI2501	
U15	IC., ECL, DUAL D FLIP-FLOP	046131	04713	MC10131	2
U16	4600A, 4800A, 4900A ONLY				
U15	IC., ECL, DUAL D FLIP-FLOP	046231	04713	MC10231	2
U16	4950A ONLY				
U17	IC., ECL, TRIPLE NOR GATE	046106	04713	MC10106	1
U18	IC., LIN., 3 TERM VOLT. REG., 5V	048005	07263	7805	1
U19	IC., LIN., 3 TERM VOLT. REG., 12V	048012	07263	78M12	1
S1	SW., SLIDE SPDT	063100			1
S2	SW., 115/230V SLIDE DPDT	063110			1
T1	XFMR., 115/230V., 16VA	053460			1
J	CONNECTOR, CINCH	061020	CINCH	252-10-30-160	3
J1	1 SOCKET IC., 24 PIN	061224			

FIGURE 5-2
MAIN PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	DIRECT AMPLIFIER PCB ASSEMBLY				
	DIRECT PREAMP PCB ASSEMBLY	085462		085462	1
	Figure 5-3				
C1	CAP., MYLAR, 0.1UF, 10%, 250V	011131	73445	C280AE/A100K	1
C2	CAP., CER. DISC., 47PF, 20%, 500V	011108	56289	C030B102H470J	4
C3					
C15					
C16					
C4	CAP., TA., 47UF, 20%, 16V	011205			
C5	CAP., CER. DISC., 0.01UF, 20%, 25V	011127	32897	5835-000U5U 103Z	4
C9					
C7					
C11					
C6	CAP., TA., 10UF, 20%, 16V	011201	56289	196D106X0015 JA1	3
C12					
C17					
C8	CAP., TA., 22UF, 20%, 20V	011204	56289	196D226X0020 LA3	2
C10					
C13	CAP., CER. DISC., 22PF, 20%, 50QV	011106	72982	10TCC-Q22	2
C14					
CR1	DIODE, ULTRA FAST SWITCH, SI.	031914	07263	1N914	2
CR2					
Q1	TRANS., FET, H.F., SM. SIG.	033404	17856	E310	1
Q2	TRANS., H.F.	033305		BF357	2
Q6					
Q3	TRANS.	033202		TIS73	3
Q4					
Q5					
Q6	TRANS., SI, PNP	033101	07263	2N5771	4
Q7					
Q8					
Q9					
R1	RES., 1/4W, 5%, CC, 100 OHMS	022115	01121		2
R14					
R2	RES., 1/4W, 5%, CC, 270K	022427	01121		1
R3	RES., 1/4W, 5%, CC, 820K	022482	01121		1
R4	RES., 1/4W, 5%, CC, 270 OHMS	022127	01121		3
R25					
R26					
R5	RES., 1/4W, 5%, CC, 150 OHMS	022115	01121		1
R6	RES., 1/4W, 5%, CC, 100K	022410	01121		4

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	DIRECT AMPLIFIER PCB ASSEMBLY (Cont'd)				
R8					
R10					
R7	RES., 1/4W, 5%, CC, 82K	022382	01121		1
R9	RES., 1/4W, 5%, CC, 10K	022310	01121		2
R12					
R11	RES., 1/4W, 5%, CC, 68K	022368	01121		2
R20					
R13	RES., 1/4W, 5%, CC, 560 OHMS	022156	01121		7
R17					
R23					
R24					
R29					
R30					
R35					
R15	RES., 1/4W, 5%, CC, 1K	022210	01121		1
R16	RES., 1/4W, 5%, CC, 10 OHMS	022010	01121		2
R18					
R21	RES., 1/4W, 5%, CC, 2K7	022227	01121		4
R22					
R31					
R33					
R27	RES., 1/4W, 5%, CC, 390 OHMS	022139	01121		2
R28					
R32					
R34	RES., 1/4W, 5%, CC, 5K6	022256	01121		1
R19	RES., TRIMPOT, 10K	027310	PIHER	PT-10H-10K	1
AR1	IC., TRIPLE-LINE RECEIVER, DIP, 16 PIN	047117	07263	F95116	1
1.	SOCKET, IC., LOW PROFILE, DIP 16 PIN	061216		C931602	1
2.	COAX CABLE ASSY 5 INCH	071617		RG174/U	1

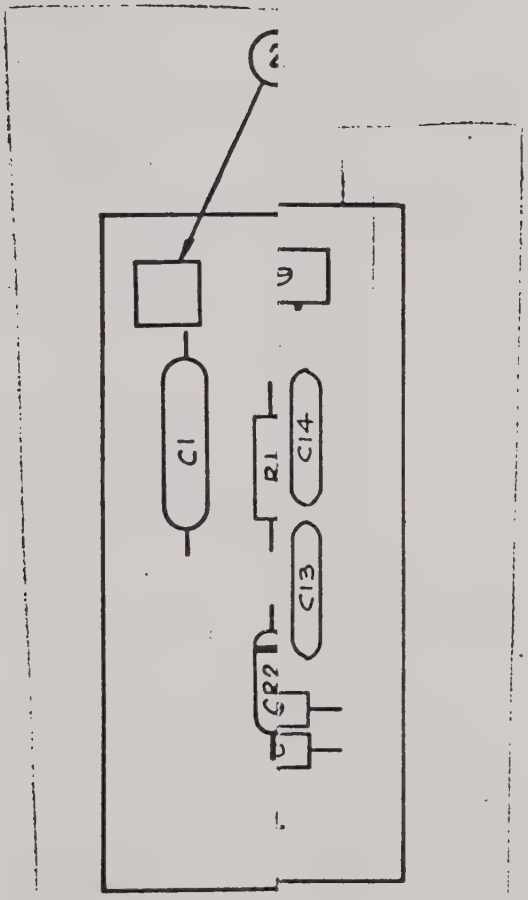


FIGURE 5-3
DIRECT AMPLIFIER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	MULTIPLIER PCB ASSEMBLY	085464		085464	1
	Figure 5-4				
C1	CAP. TA, 10UF, 20% 16V	011201	56289	196D106X0015	4
C2					
C5					
C6					
C3	CAP. CER. DISC, 0.01UF, 25V	011119	71590		1
C4	CAP. CER. DISC, 68PF, 25V	011109			1
C7	CAP. FACTORY SELECT				1
CR1	DIODE, VOLTAGE REG. SI	031755	07263	1N755	1
CR2	DIODE, ULTRA FAST SWITCH, SI	031914	07263	1N914	1
R1	RES. 1/4W, 5%, CC, 10K	022310	01121		4
R2					
R9					
R11					
R3	RES. 1/4W, 5%, CC, 100K	022410	01121		1
R4	RES. 1/4W, 5%, CC, 2.7K	022327	01121		1
R5	RES. 1/4W, 5%, CC, 180K	022418	01121		1
R6	RES. 1/4W, 5%, CC, 470 OHMS	022147	01121		4
R7					
R16					
R21					
R8	RES. 1/4W, 5%, CC, 270K	022427	01121		1
R10	RES. 1/4W, 5%, CC, 1K	022210	01121		4
R12					
R14					
R18					
R13	RES. 1/4W, 5%, CC, 2.2K	022222	01121		2
R15					
R17	RES. 1/4W, 5%, CC, 5.6K	022256	01121		2
R19					
R20	RES. 1/4W, 5%, CC, 560 OHMS	022156	01121		1
Q1	TRANS. H.F.	033305	Philips	BF357	2
Q3					
Q4					
Q5					
Q6					
Q2	TRANS. SI,	033104		2N4342	1
Q6	TRANS. SI, PNP	03101	07263	2N5771	5
Q7					
Q8					
Q9					
Q					
Q					

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY
	MULTIPLIER PCB ASSEMBLY (Cont'd)				
U1	*IC, CMOS, PHASE LOCKED LOOP*	*044046*	*95303*	*CD4046AE*	*1*
U2	*IC, CMOS, DECADE COUNTER*	*044017*	*95303*	*CD4017AE*	*3*
U3					
U4					
1	*SOCKET, IC, LOW PROFILE, DIP, 16 PIN*	*061216*		*C931602*	*1*

INSTRUCTION MANUAL

PRELIMINARY

4000 SERIES

ELECTRONIC COUNTERS

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WARRANTY

NAVIGATION TECHNOLOGY LTD. warrants each instrument manufactured by them to be free from defects in material and workmanship for one year from the date of original purchase. Their obligation under this warranty is limited to servicing an instrument returned to the factory and to making good at the factory any parts, except tubes, fuses, and batteries, which are found defective upon their examination. This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons, which have been subjected to misuse, negligence, or accident, or which have had the serial number altered, effaced, or removed. This warranty is in lieu of all other warranties whether expressed or implied. Navigation Technology Ltd. shall not be liable for any special, incident or consequential damages arising from the use of this instrument.

SHIPPING

When returning any instrument for service, the factory must be informed of the nature of the suspected trouble. The instrument should be shipped prepaid via suitable carriers in the original packing carton supplied, to:

Navtel Limited
8481 Keele Street, Unit 12A
Concord, Ontario L4K 1B1

Attn: Instrument Repair Department

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing list unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to Navigation Technology Ltd. Please include the model number, type number and serial number of the instrument with the report.

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Section 1

Introduction & Specifications

1-1 INTRODUCTION

1-2 The 4000 Series of counters was designed primarily for telecommunications applications. Four different models cover the frequency range from 5 Hz to 1.25 GHz. The units are compact and housed in a rugged all metal case which can withstand years of field abuse. An optional battery-powered version of the counter permits use at remote or mobile installations.

1-3 The display is eight digits, light-emitting-diode type with leading-zero suppression and automatic decimal point positioning. Display resolution is front-panel selectable at 1 kHz, 100 Hz, 10 Hz, 1 Hz or 0.1 Hz. Annunciators are provided to indicate the measurement units of MHz, kHz, or Hz and overflow when the capacity of the display is exceeded. All displayed measurement data is also available in a CMOS-compatible, parallel BCD output at a rear-panel connector when the unit is equipped with an optional Data Output Option -04.

1-4 All counters of the series have a direct high impedance input covering the frequency range from 5 Hz to 125 MHz. Models 4800A, 4900A and 4950A also provide a 50 ohm prescaled input to extend the upper frequency range. A front panel potentiometer provides variable gain control on all models.

1-5 The 4000 Series also incorporates an optional high-resolution mode (Option -02) to permit the measurement of low frequency signals, such as signalling tones, while using conveniently short gate times. In this mode, input signals in the range of 50 Hz to 5 kHz are multiplied by a factor of 1000 allowing the use of shorter gate times for better resolution. A self-check mode of operation is also provided to verify proper overall performance of the digital circuitry and the display of the unit prior to use.

1-6 Power requirements for the 4000 Series are 100, 115 or 230 Volts at 50 to 400 Hz for the line-powered version. Units with Option -01 are equipped with rechargeable nickel-cadmium batteries which provide a minimum of three hours of operation. The battery-powered units also operate from the AC power line, and at the same voltages as the line-powered instruments.

1-7 The standard time base has an aging rate of $\pm 3 \times 10^{-7}$/month and $\pm 2.5 \times 10^{-6}$, $0^{o}C$ to $50^{o}C$. An optional TCXO (Option -03) provides an aging rate of $\pm 3 \times 10^{-7}$/month and $\pm 5 \times 10^{-7}$, $0^{o}C$ to $50^{o}C$. In addition, an external time base signal of 1 MHz, 5 MHz or 10 MHz may be connected via a rear-panel BNC connector.

1-8 SPECIFICATIONS

1-9 The specifications for the 4000 Series are listed in the following table.

TABLE 1-1 4000 SERIES SPECIFICATIONS

FUNCTIONS		
DIRECT AMPLIFIER INPUT A	4600A, 4800A, 4900A, 4950A	
	Frequency Range:	5 Hz to 125 MHz
	Input Impedance:	1 M ohm with 30 pF max.
	Sensitivity:	15 mV rms up to 100 MHz decreasing to 25 mV rms at 125 MHz. Sensitivity variable by means of front panel potentiometer
	Overload:	150 V rms up to 1 kHz decreasing to 5 V rms at 125 MHz
	Gate Times:	1 ms, 10 ms, 0.1 s, 1 s, 10 s
	Accuracy:	± (1 count + time base accuracy)
PRESCALED AMPLIFIER INPUT B	4800A, 4900A, 4950A	
	Frequency Range:	80 MHz to 520 MHz - 4800A 80 MHz to 1000 MHz - 4900A 80 MHz to 1250 MHz - 4950A
	Input Impedance:	50 ohm, VSWR 2.5:1 max. @ 1 V rms input level
	Sensitivity:	15 mV rms to 520 and 1000 MHz decreasing to 50 mV rms at 1250 MHz. Sensitivity variable by means of front panel potentiometer
	Overload:	5 V rms, fuse protected on front panel
	Gate Times:	4 ms, 40 ms, .4 s, 4 s, 40 s; 8 ms, 80 ms, .8 s, 8 s, 80 s, (1000 and 1250 MHz)
	Accuracy:	± (1 count + time base accuracy)

TABLE 1-1 4000 SERIES SPECIFICATIONS (Cont'd)

RESOLUTION MULTIPLIER (OPTION -02)

Frequency Range:	50 Hz to 5 kHz
Lock-Up Time:	1.5 seconds max.
Gate Times:	1 ms, 10 ms, .1 s, 1 s, 10 s
Accuracy:	± (2 counts ± time base accuracy)

SELF CHECK

The Reference Oscillator is internally connected to the digital logic input. Pressing RESET automatically lights all segments of each display digit.

TIME BASE

	STANDARD	-03 OPTION
Frequency:	10.00 MHz	10.00 MHz
Aging Rate:	$\pm 3 \times 10^{-7}$/Mth.	$\pm 3 \times 10^{-7}$/Mth.
Temperature Stability 0 - 50°C	$\pm 2.5 \times 10^{-6}$	$\pm 5 \times 10^{-7}$
Line Voltage (±10% change)	$\pm 1 \times 10^{-7}$	$\pm 5 \times 10^{-8}$

EXTERNAL TIME BASE INPUT

Frequency Required:	1 MHz, 5 MHz or 10 MHz
Sensitivity:	1 V rms
Impedance:	2 k ohms, 40 pF
Overload:	20 V rms

OUTPUTS (OPTION -04)

Provides parallel BCD CMOS compatible outputs from each digit plus overflow, units annunciation, decimal point and print command.

GENERAL

Operating Temperature Range:	0° to 50°C 0° to 40°C (charging Option -01)
Charge Time (Option -01):	14 hours (not operating)
Discharge Time (Option -01)	3 hours min.
Power Requirements:	50 - 400 Hz, 115/230 V ± 10%, (100 V ± 10% optional) 15 Watts typical
Weight:	3.5 kg. 4.5 kg. with Option -01

Section 2

Operating Instructions

2-1 *INTRODUCTION*

2-2 *This section contains operating information for 4000 Series counters. The contents of this section should be read before operating the counter. Should any difficulties arise during operation of the instrument, please contact Navigation Technology Ltd., 3530 Pharmacy Avenue, Scarborough, Ontario M1W 2S7.*

2-3 *SHIPPING INFORMATION*

2-4 *The counter is packaged and shipped in a protective container. Upon receipt of the equipment, a thorough inspection should be made to reveal any possible shipping damage.*

2-5 *If reshipment of the equipment is necessary, the original container should be used. If the original container is not available a new container can be obtained from Navigation Technology Ltd. Please reference the equipment model number when requesting a new shipping container.*

2-6 *INPUT POWER*

2-7 *Both the line-powered and battery-powered versions operate from either a 115 V or 230 V AC power line. Before connecting to the power line, ensure that the internal line power selection switch is in the position which corresponds to the power line voltage. Also check that the correct value fuse is installed as specified on the rear panel decal.*

2-8 *RACK INSTALLATION*

2-9 *4000 Series counters may be centre-mounted in a standard 19-inch rack when supplied with the appropriate rack mounting kit. Instructions for installing units in the rack mount are supplied with the rack mounting kit. Please contact the factory for additional information.*

2-10 *POWER FUSE*

2-11 *Power supply protection is provided by means of a line fuse having a rating of 500 mA AGC for 115 V, and 250 mA AGC for 230 V input.*

2-12 HANDLE ADJUSTMENT

2-13 The handle/tilt stand positions the instrument in three different viewing angles. To index the handle, pull it firmly away from the counter and rotate to the desired position. Ensure that the handle is returned firmly to the side of the instrument before use.

2-14 CONTROLS, INDICATORS AND CONNECTORS

2-15 The location and function of all controls, indicators, and connectors are shown in Figure 2-1 and described in Table 2-1.

TABLE 2-1 CONTROLS AND INDICATORS

ITEM NO.	NAME	FUNCTION
1	5 Hz - 125 MHz 1 M ohm BNC connector A	Provides connection to the direct (non-prescaled) input of the counter for signals in the range of 5 Hz to 125 MHz.
2	80 MHz - 520 MHz 50 ohm BNC connector B (80MHz-1 GHz or 1.25 GHz)	Provides connection to the prescaled input of the counter for signals in the range of 80 MHz to 520 MHz on the 4800A. (80 MHz to 1 GHz and 80 MHz to 1.25 GHz are available with 4900A and 4950A respectively).
3	Gate Lamp	Lights to indicate a measurement is being made.
4	Lock Lamp (Option -02)	Part of Option -02 lights when the X1000 frequency multiplier (high resolution) function is selected and the frequency multiplier has not yet achieved phase lock-up, giving an ambiguous display.
5	Over Lamp	Lights to indicate that the display capacity has been exceeded.
6	Display LED's	Display consists of eight digits. Leading zeros are suppressed.
7	Hz Lamp	Lights to indicate display is reading Hz.
8	kHz Lamp	Lights to indicate display is reading kHz.
9	MHz Lamp	Lights to indicate display is reading MHz.
10	POWER Switch	A push-push switch to energize the counter.
11	RESOLUTION Switches	A series of five switches to select the desired measurement resolution. For example, if 10 Hz Resolution is selected, the least significant digit represent 10 Hz.
12	RST Switch	A push-button switch when pressed resets the counter to zero and initiates another measurement. When pressed with CHECK function selected, causes all correctly operating display segments to illuminate.

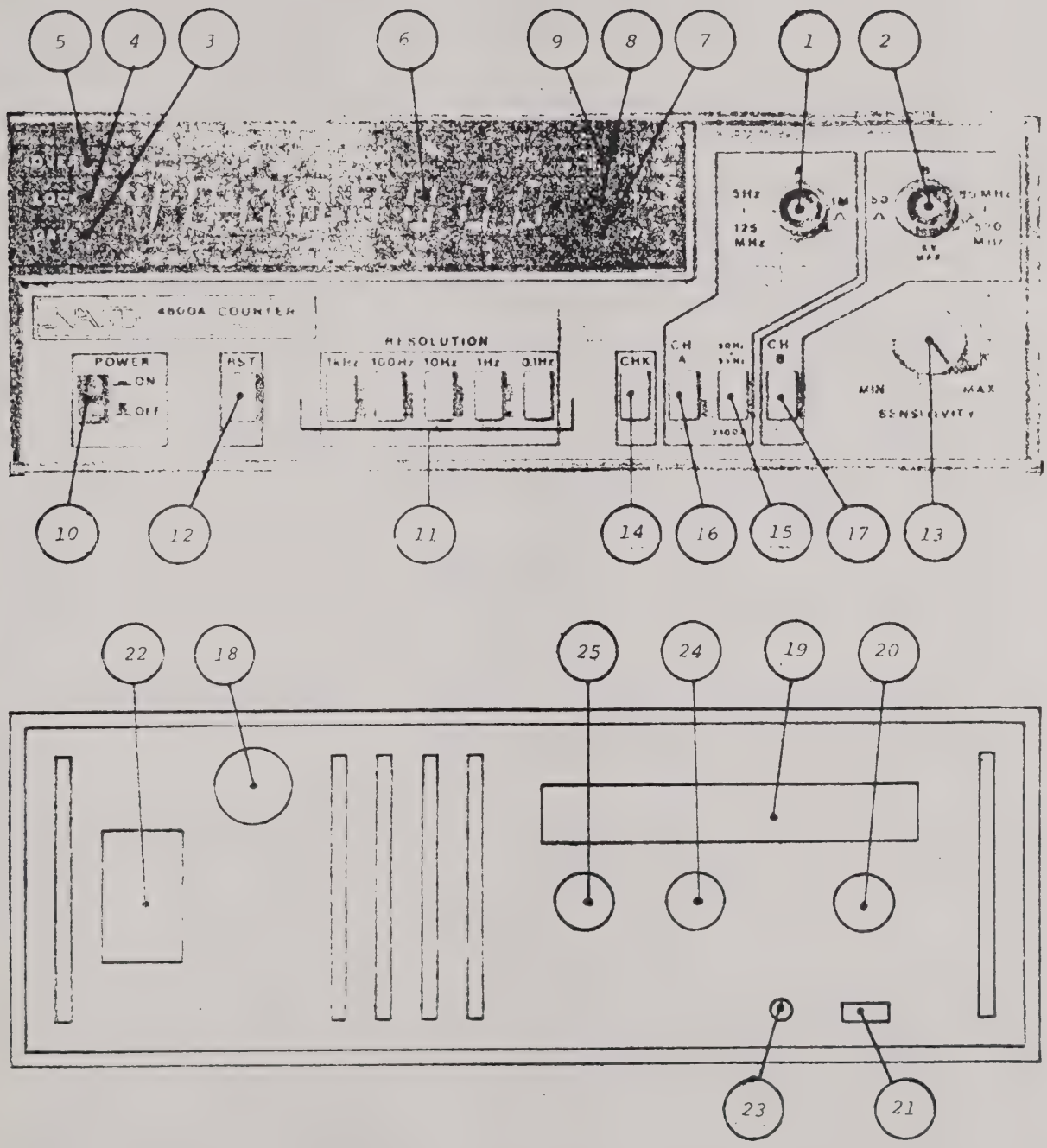

FIGURE 2-1
CONTROLS, INDICATORS AND CONNECTORS

TABLE 2-1 CONTROLS AND INDICATORS (Cont'd)

ITEM NO.	NAME	FUNCTION
13	Sensitivity Control	A potentiometer which controls the gain of Channel A and Channel B (4800A, 4900A and 4950A only)
14	CHK Switch	A push-button switch to select the Self-Check mode of operation.
15	50 Hz - 5 kHz, x1000 switch (Option -02)	A push-button switch to select the high resolution mode of operation. Operational only when Option -02 installed.
16	Channel A Switch	A push-button switch to select the direct (non-prescaled), input for measurement of signals in the range of 5 Hz to 125 MHz.
17	Channel B Switch	A push-button switch to select the prescaled input for measurement of signals in the range of 80 MHz to 520 MHz, 4800A; 80 MHz to 1 GHz, 4900A; 80 MHz to 1.25 GHz, 4950A.
18	Line Fuse	Provides quick disconnect from AC line, should malfunction occur.
19	BCD Connector (Option -04)	A 50-pin PCB connector which accesses measurement data when the Data Output Unit, Option -04 is installed.
20	CLOCK Connector	Provides for connection of an external time base signal of 1 MHz, 5 MHz or 10 MHz (depending on internal jumper configuration) when the INT/EXT switch is placed in the EXT position.
21	INT/EXT Switch	Slide switch to select either the internal time base or a time base signal applied to the CLOCK Connector.
22	Power Connector	Provides connection through line cord to AC power line.
23	CLOCK ADJ.	Trim adjustment for internal clock.
24	Clock Output Connector	Provides connection for internal 10 MHz clock. Special configuration, consult factory.
25	AUX Connector	Special configuration, consult factory.

2-16 SELF-CHECK MODE

2-17 The self-check mode provides a means of verifying proper overall operation of the counter, excluding the direct input amplifier, the prescaled input amplifier and the high resolution multiplier. To self- check unit, proceed as follows:

a. Press the Power switch to the ON position.

b. Press the CHK switch.

c. Press the RST switch. All display segments should light. The display should read 88888888

d. Press the 1 kHz RESOLUTION switch. The display should read 1.000 MHz ± 1 digit.

e. Press the 100 Hz RESOLUTION switch. The display should read 1.0000 MHz ± 1 digit.

f. Press the 10 Hz RESOLUTION switch. The display should read 1000.00 kHz ± 1 digit.

g. Press the 1 Hz RESOLUTION switch. The display should read 1000.000 kHz ± 1 digit.

h. Press the 0.1 Hz RESOLUTION switch. The display should read 1000.0000 kHz ± 1 digit.

2-18 FREQUENCY MEASUREMENTS

2-19 INPUT CONNECTIONS

2-20 Signals to be measured by the counter are applied to the front panel BNC input connectors. The A Input (4600A, 4800A, 4900A and 4950A) accepts signals in the range of 5 Hz to 125 MHz; the input impedance is 1 megohm shunted by less than 30 pF. The B Input (4800A, 4900A and 4950A only) accepts signals in the range 80 MHz to 520 MHz, Model 4800A; 1 GHz, 4900A; and 1.25 GHz for the 4950A. Input Impedance of the B Channel is 50 ohms nominal.

2-21 INPUT A DIRECT MODE

2-22 The 5 Hz to 125 MHz input is used in the direct measurement mode. This input is protected from overload to withstand inputs as high as 150 Volts rms at frequencies below 1 kHz without damage. Overload capability decreases from 150 Volts rms at 1 kHz to 5 Volts rms at 125 MHz.

2-23 To make frequency measurements in the direct mode, proceed as follows:

a. Connect the input signal to the A Channel input connector. A standard ÷1 oscilloscope probe may be used for this purpose. The input impedance can be further enhanced by using a ÷10 oscilloscope probe, but with some accompanied loss in sensitivity.

b. Rotate the sensitivity control to the MAX. position, and press the CHA switch.

c. Select the desired resolution, and read the measurement on the display.

d. For signals with a high noise content or ringing, the sensitivity of the counter may be reduced by rotating the sensitivity control towards the MIN. position.

2-24 INPUT B PRESCALED MODE

2-25 The 50 MHz to 520 MHz (1 GHz, or 1.25 GHz) input is used in the prescaled measurement mode. This input is protected from overload to withstand inputs as high as five Volts rms without damage. (Overload protection is provided by a panel mounted 1/10A fuse).

2-26 To make frequency measurements in the prescaled mode, proceed as follows:

a. Connect the input signal to the B Channel input.

b. Rotate the sensitivity control to the MAX. position, and press the CHB switch.

c. Select the desired resolution and read the measurement on the display.

d. For signals with a high noise content, the sensitivity of the counter may be reduced by rotating the sensitivity control towards the MIN. position.

2-27 HIGH RESOLUTION MODE, OPTION -02

2-28 In order to make conveniently rapid measurement of low frequency signals, a high resolution mode of operation is available which shortens the internal gate times and speeds-up measurement cycles. For example, a low frequency tone being measured with a resolution of 0.1 Hz would normally require a gate time of ten seconds. To adjust the frequency of the tone while observing the counter would be extremely difficult due to the time lag between the adjustment and the resultant display on the counter. The high resolution mode eliminates the problem by multiplying the input signal by a factor of 1000, which allows a shorter gate time to be selected. In this mode, 0.1 Hz resolution is obtained by pressing the 100 Hz switch to select a gate time of ten milliseconds instead of ten seconds.

2-29 To make measurements in the high resolution mode, proceed as follows:

a. Connect the 50 Hz to 5 kHz input signal to the Channel A BNC connector.

b. Press the 50 Hz to 5 kHz x1000 switch.

c. Select the desired resolution. Note that the resolution is increased by a factor of 10^3 so that selection of 1 Hz resolution is actually 0.001 Hz resolution, 10 Hz is actually 0.01 Hz, etc.

d. Read the measurement on the display.

NOTE

If the LOCK lamp lights or flashes while the display reads zero, the upper or lower frequency limit of the input multiplier has probably been exceeded.

2-30 EXTERNAL CLOCK

2-31 The 4000 Series counters permit the use of an external time base in substitution for the internal time base. The external time base may be 1, 5, or 10 MHz, in the range 1 V rms to 20 V rms. Input impedance is .2 K ohms, and connection is made via the rear panel clock connector. The INT/EXT slide switch is placed in the EXT position. The counter is factory wired for a 10 MHz external reference signal. Consult the factory for details on operation at other frequencies.

2-32 BATTERY POWERED OPERATION, OPTION -01 to be supplied in final manual.

2-33 DATA OUTPUT UNIT, OPTION -04 to be supplied in final manual.

Section 3

Theory of Operation

3-1 INTRODUCTION

3-2 This section of the manual contains an overall functional description of 4000 Series counters followed by a more detailed circuit analysis.

3-3 OVERALL FUNCTIONAL DESCRIPTION

3-4 Generally, the frequency of any signal is measured by counting the number of cycles of the unknown signal for a known length of time, referred to as the gate time. Gate time is usually equal to seconds at some power of ten, i.e. one millisecond, ten milliseconds, etc. The longer the gate time, the greater the measurement resolution. The accumulated count of the input signal cycles is then fed to the display section where it is observed by the operator.

3-5 As shown in Figure 3-1, 4000 Series counters are comprised of direct amplifier, an optional X1000 multiplier, a prescaler, a main gate, decade counters, a digital display, program control logic, a time base and time base dividers. The unknown signal is applied to either the direct amplifier or the prescaler input where it is limited, amplified and shaped to a squarewave for application to one input of the main gate. If the signal is applied to the prescaler, it is also divided by a factor of four (or by a factor of eight in the 1 GHz and 1.25 GHz prescalers) for application to the main gate. In the high-resolution mode, the input signal is routed through the multiplier before being applied to the main gate.

3-6 In order for the input signal to be applied to the decade counters, a main gate enable signal is required at the input of the counters. The main gate enable signal is derived from the 10 MHz output of the time base (or external reference) and the time base dividers. The 10 MHz time base signal is applied to the range control and time base dividers, where it is divided by a factor of 10^4, 10^5, 10^6, 10^7, or 10^8, depending upon which range (degree of resolution) is selected. If the 1 kHz resolution is selected, the TCXO output is divided by a factor of 10^4 to yield a time base having a period of one millisecond (0.001 seconds). For a time base of ten milliseconds, a division factor of 10^5 is used, and so on.

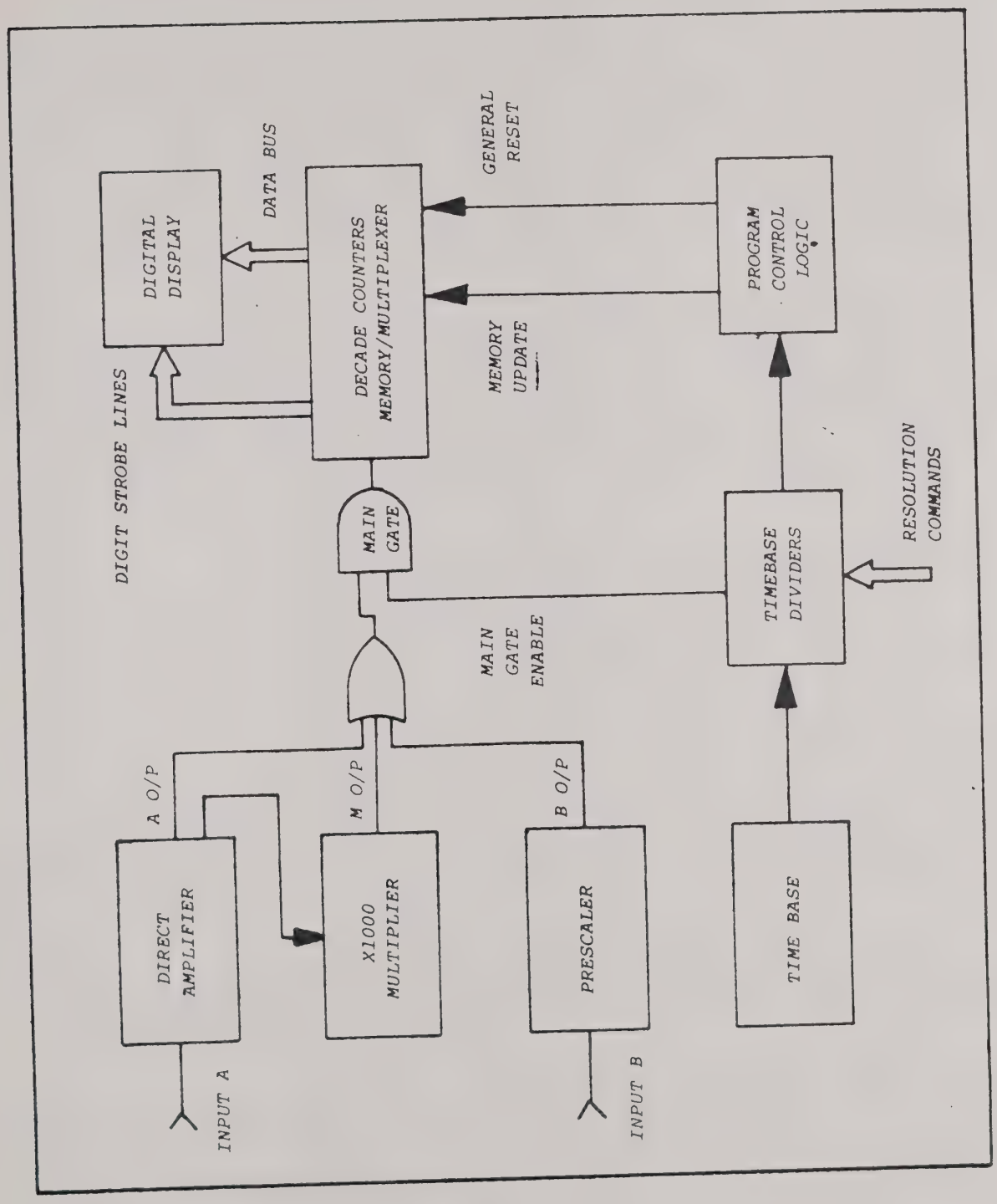

FIGURE 3-1
OVERALL BLOCK DIAGRAM

3-7 The above division factors apply only to the direct amplifier mode. The prescaler mode requires additional time base division to achieve longer gate times since the input signal undergoes some division in the prescaler. In the 520 MHz prescaler, the additional division is by a factor of four. In the 1 GHz and 1.25 GHz prescalers, the additional division is by a factor of eight. As a result, the time base division for the 520 MHz prescaler version of the Model 4800A is 4×10^4, 4×10^5, 4×10^6, 4×10^7 and 4×10^8. For the 1 GHz and 1.25 GHz versions, time base division is by factors of 8×10^4, 8×10^5, 8×10^6, 8×10^7 and 8×10^8.

3-8 The divided time base signal is applied to the main gate and enables the signal under measurement to pass through to the eight series-connected decade counters for one full period of the divided time base. The decade counters continue to accumulate the gated pulses from the input signal as long as the main gate enable signal is present. (i.e. for the period of the time base). At the end of the time base period, the main gate is inhibited and the counters no longer receive input pulses. At this time, the program control logic issues a memory update command to the display memory, causing the contents of the eight decade counters to be stored in eight memory units until the next memory update command occurs.

3-9 There are eight decade counters, eight four-bit memory units and eight display light-emitting diodes (LED's). However, the contents of only one memory unit (one digit of measurement data) is displayed on its corresponding LED at any given time. A display multiplexer sequentially places the contents of each memory unit on a measurement data bus for a period of approximately 125 microseconds. The measurement data bus is commonly connected to all digits (LED's) in the display. However, only that digit which corresponds to the memory unit being gated is enabled by means of a strobe line. As the next memory unit is gated onto the measurement data bus, the next digit is strobed to display that data. As each memory unit is gated, the corresponding LED is strobed to display the data placed on the measurement data bus, resulting in a scanning action of the display. By sequencing through the display memory and lighting each LED for only 12% of the full strobe cycle, LED power consumption is minimized. Persistence of the eye eliminates any effects of flicker.

3-10 While the last measurement is being displayed, the program control logic initiates the next measurement by generating a general reset command, to initialize various elements of the control logic. The general reset command is also used to reset the eight decade counters back to zero in preparation for the next measurement.

3-11 Operation in the self-check mode is similar to that described for the frequency mode except that the unknown input is replaced by the 1 MHz output of the time base.

3-12 CIRCUIT ANALYSIS

3-13 DIRECT AMPLIFIER (REF FIGURE 6-3)

3-14 The main function of the direct amplifier is to condition input signals prior to application to the main gate or the multiplier circuit. As shown in Figure 6-3, the 5 Hz to 125 MHz input signal is fed to a FET input buffer Q1 and Q2 whose input is limited (protected by diodes CR1 and CR2). The output of the buffer feeds the attenuator FETS Q3 and Q4 and the wide band amplifier (Q6, Q7, Q8). The output of this amplifier feeds a series of three operational amplifiers (contained in a single package, AR1). Each amplifier is equipped with a double ended input and output. A reference voltage line biases the first amplifier.

3-15 The first amplifier of AR1 operates in an open loop mode. The second amplifier is provided with positive feedback via R27 and R28. This amplifier operates as a Schmitt trigger to provide fast rise-times for low frequency inputs prior to application to the digital circuits within the counter. The input level at which the Schmitt fires is controlled by R19, the trigger level control. The third amplifier operates as a one shot and buffer to isolate the Schmitt trigger from following stages.

3-16 The attenuator FETS are controlled by the sensitivity control. This DC signal is fed through R6 and Q5 to the FETS Q3 and Q4.

3-17 The output of the Schmitt trigger is fed through Q9 to provide a square wave output to the multiplier circuit. (P4, Pin 7)

3-18 520 MHZ PRESCALER 4800A (REF FIGURE 6-4)

3-19 The main function of the prescaler is to reduce the frequency of the input signal to below 130 MHz for application to the main gate and decade counters. The prescaler also provides the necessary conditioning of the input signal to provide sufficient gain and the proper waveshaping. The frequency division factor for the 520 MHz prescaler is four.

3-20 As shown in Figure 6-4, the input signal is fed through the input protection fuse to the limiting diodes CR1 and CR2. Pin diode CR3 and R4 provide attenuation which is controlled by the sensitivity control through R2 and R3.

3-21 The input signal is then amplified by Q1, Q2, Q3 and Q4 and fed through U1 which divides by a factor of four to reduce the input frequency to below 130 MHz. The prescaled signal is then fed to the main PCB for application to the main gate. (Pin 1, P5)

3-22 The output of Q4 is also fed to a detector circuit where it is rectified by CR5 and CR4 and amplified by AR1. The DC output of AR1 is fed to Q5 which will clamp the prescaler output to +5 V if the input signal is interrupted, or reduced to below minimum acceptable amplitude. This amplitude is controlled by R30.

NOTE

The prescaler, like the direct amplifier, is energized only when that mode is selected. When not selected, the front panel mode switch interrupts its power supply connection.

3-23 1 GHZ AND 1.25 GHZ PRESCALERS 4900A, 4950A
(REF FIGURE 6-8)

3-24 The main function of the prescaler is to reduce the frequency of the input signal to below 160 MHz for application to the main gate and decade counters. The prescaler also provides the necessary conditioning of the input signal to provide sufficient gain and the proper waveshaping. The frequency division factor for the prescaler is eight.

3-25 As shown in Figure 6-8 the input signal is fed through an input protection fuse to the input of the amplifier, which contains input limiting. The output of the amplifier, which is also internally limited, is applied to a divider circuit which divides by a factor of eight to reduce the input frequency to below 160 MHz. The prescaled signal, amplified by AR1 and divided by U1 and U2 is fed to the main PCB assembly for application to the main gate and decade counters. (Pin 1, P5)

3-26 The output of the amplifier is also fed to a detector circuit where it is rectified by CR1 and amplified by AR3. The DC output of AR3 is fed to Q1 which will inhibit the divider U2 if the input signal is interrupted, or reduced to below minimum acceptable amplitude. This amplitude is controlled by R4 and also by the sensitivity control through R1 and AR2. For the 1.25 GHz version, the amplifier AR1 and divider U1 are factory selected for reliable high frequency operation.

NOTE

The prescaler like the direct preamplifier is energized only when that mode is selected. When not selected, the front panel mode switch interrupts its power supply connection.

3-27 MAIN GATE, DECADE COUNTERS (REF FIGURE 6-1)

3-28 As shown in Figure 6-1, the gating of the input signals from the direct amplifier (A O/P), prescaler (B O/P), multiplier (M O/P) or the time base oscillator (SCHK) to the decade counters is accomplished by U17. The main gate controls the application of these signals at a "wire or" enable at the output of U17. This output is connected to the first decade counter. This decade counter consists of four ECL flip flops U15, U16 interconnected to divide by 10 in a 1-2-4-8 BCD format. The output of the first decade is fed through U11 to the second decade TTL counter U14.

3-29 The remaining counter circuitry (six decades) as well as the display memory, display multiplex and data bus are contained in a single LSI MOS circuit U13. The binary outputs of the first decade are level shifted by transistors Q5 to Q10 and fed with the outputs of the second decade to the display memory internal to U13.

3-30 DISPLAY MEMORY

3-31 The function of the display memory is to store the BCD contents of the decade counters after the measurement has been made, so that the multiplexer has access to settled data at all times. Without the display memory, the display would directly reflect the counting action of all the decade counters, making it difficult to observe the final measurement.

3-32 The display memory comprises a set of eight four-bit latches which accept their applied BCD inputs during the presence of a memory update command $\overline{M}$. The memory update command is generated by the control logic when it has determined that the contents of the decade counters are ready for display. (The control logic is described later in this section).

3-33 DISPLAY MULTIPLEXER

3-34 The function of the display multiplexer is to sequentially gate each digit of measurement data from the outputs of the display memory onto a bus which is commonly connected to all display LED's. In conjunction, the display multiplexer also enables the corresponding LED at the same time its respective measurement data is placed on the bus. The Display multiplexer comprises a series of eight four-bit gating circuits, an oscillator, an eight stage counter and a measurement data bus (four-bit BCD). The oscillator drives the eight stage counter through a complete cycle every millisecond. Each output is true for a period of 100 microseconds, providing a 25 microsecond guard period between each output.

3-35 As the counter progresses through its cycle, each of the gating circuits is sequentially enabled for a period of 100 microseconds to place its respective digit of measurement data on the measurement data bus for application to the display LED's. At the same time the digit of measurement data is placed on the bus, the counter output feeds the digit strobe line, via the corresponding LED drivers U9, to enable the corresponding display LED.

3-36 Prior to application to the display, the BCD measurement data is decoded by U10 to the seven-line format required by the display LED's. The display LED's are common cathode types and operate between the current sourcing decoder U10 and the current sinking strobe drivers U9. Current limiting is provided by a seven resistor network U5. The BCD-to-seven segment decoder is inhibited by zero suppression logic whenever non-significant leading zeros are placed on the measurement data bus.

3-37 DECIMAL POINT POSITIONING

3-38 The position of the decimal point in the display is a function of the RESOLUTION switches and is determined by the coincidence of the digit strobe line and a signal on the decimal point bus DP. For example, if the 10 Hz RESOLUTION switch is pressed, then the S3 strobe line is connected to the decimal point bus. Each time a pulse appears on the S3 line, a pulse will appear on the decimal point bus. As a result, the S3 LED receives a pulse on the cathode enable input at the same time a pulse is present on the decimal point driven by U1. Since the pulse is present on the decimal point bus only during the period of S3 only the S3 decimal point lights.

3-39 TIME BASE OSCILLATOR

3-40 The oscillator, shown in Figure 6-1, is a crystal controlled colpitts which operates at 10 MHz (Q4). The 10 MHz signal is squared by Q3 and U12 and applied to decade counter U4, to obtain an output of 1 MHz.

3-41 The 1 MHz is further divided by U3 if operation is in the prescale mode. For the 520 MHz prescaler, in the 4800A, a division ratio of 4:1 is used. For the 4900A and 4950A, a division ratio of 8:1 is used.

3-42 TIME BASE DIVIDERS

3-43 The function of the time base dividers is to divide the 1 MHz (250 kHz or 125 kHz in the prescale mode) time base signal (REF CLOCK) by a selected power of ten to obtain the proper main gate signal. The time base dividers are contained within a single integrated circuit U1 which receives division commands from the front panel RESOLUTION switches, via CR6, CR3, CR4 and CR7.

3-44 CONTROL LOGIC

3-45 The control logic controls the sequence of events which take place throughout the counter in order to make a measurement and display the result. The control logic sequences through the measurement cycle at a rate determined by a 50 Hz relaxation-type oscillator Q11 and the selected gate time (resolution). The measurement cycle consists of the following basic steps:

a. A general reset command R is issued to initialize the control logic and decade counters.

b. The main gate is enabled for a period of time which corresponds to the selected resolution. During this time, the decade counters accumulate the input pulses passed by the main gate.

c. At the end of the main gate time, the main gate is inhibited and a memory update command M is issued to load the display memory with the contents of the decade counters.

d. With the measurement data loaded into the display memory, the display multiplexer sequentially displays each digit of data on the respective LED until the display memory is updated with the results of the succeeding measurement.

3-46 The following discussion describes the measurement cycle with reference to Figure 6-1. As a starting point, assume the sequencer U7, which is basically a ten-stage ring counter, is at count state four. State four is a general reset command R which is used to initialize the control logic and reset the decade counters to zero. The sequence advances through states five, six and seven to state eight, and removes the reset signal RMAX from the time base divider U1.

3-47 For all states of the sequencer, except state eight, the RMAX signal is high to reset and hold the time base divider at minimum count (i.e. 999.) When the RMAX signal goes low, the time base dividers are allowed to count and will wrap-around to zero upon receipt of the first pulse of time base signal from the time base oscillator. When the time base dividers wrap-around to zero, a falling pulse-edge appears at the clock input of the gate time flip-flop (U2). This negative-going transition sets the gate time flip-flop and enables the main gate. During the time the main gate is enabled, the decade counters accumulate the input signal.

3-48 The application of the main gate through U6 resets and holds the sequencer to count state zero while the gate is enabled.

3-49 Also during this time, the time base dividers are being allowed by U8 to count the input pulses (time base signal) being applied to their input. This action continues until the time base dividers reach full count (i.e. 999.) and wrap-around to zero again, to produce a second negative-going transition at the clock input of the gate time flip-flop. At this time the gate time flip-flop is reset, the main gate is inhibited and no further input pulses reach the decade counters.

3-50 With the reset now removed, the sequencer advances from state zero to state 1 and state two. At state two, a memory update command M is generated and fed to the display memory. The memory update command causes the display memory to be updated with the new data. This data is then multiplexed and displayed.

3-51 Sequence state three is not used and the sequencer proceeds to state four to begin the next measurement cycle with a general reset.

3-52 MULTIPLIER CIRCUIT (OPTION-02) (REF FIGURE 6-5)

3-53 The multiplier circuit is used in the high resolution mode of operation to increase the frequency of the input signal by a factor of 10^3, thereby permitting shorter gate times during low frequency measurements. When the high resolution mode is not selected on the front panel switch power is removed, and the entire circuit is disabled and consequently provides no output.

3-54 Figure 6-5 shows that the input signal is fed from the direct amplifier to one input of a digital frequency/phase comparator U1. The second input to comparator receives the actual output of the multiplier circuit after being divided by a factor of 10^3 (U2, U3, U4). When the output of the multiplier is exactly 1000 times greater than the input from the direct amplifier, the two comparator inputs are in phase and a constant DC level is present at the VCO input. The comparator output filtered by R3, R4 and C1, drives Q2 and controls the charging rate of C4. The voltage across C4 is applied to the input of a Schmitt trigger (Q4, Q5, Q6, Q7). The Schmitt trigger causes Q3 to discharge C4, to begin the action over again.

3-55 The output of the Schmitt trigger is buffered (Q8, Q9, Q10) and fed to the main gate and decade counters (P6, Pin 1). The output is also divided by 1000 and fed back for comparison with the input from the direct amplifier to form a phase-locked loop. Any frequency or phase difference between the two inputs will cause the output to change to maintain multiplied output equal to 1000 times the input. The phase comparator also provides a DC output to light the LOCK lamp and reset the counters whenever the multiplier is not locked in phase. This condition occurs during start-up or when an invalid input is present at the multiplier.

3-56 BATTERY CIRCUIT, OPTION -01 to be supplied in final manual

3-57 DIGITAL OUTPUT UNIT, OPTION-04 to be supplied in final manual

Section 4

Maintenance

4-1 INTRODUCTION

4-2 This section contains information concerning preventive and corrective maintenance for 4000 Series counters. Equipment for performing maintenance tests and adjustments is listed in Table 4-1. If this equipment is not available, other equipment having equivalent specifications may be used.

TABLE 4-1 TEST EQUIPMENT REQUIRED

EQUIPMENT TYPE	REQUIRED BASIC SPECIFICATIONS	WHERE USED	RECOMMENDED MANUFACTURER
Quartz oscillator frequency standard 10 MHz output	Short term stability to be better than 1×10^{-8}	Time base oscillator Adjustment	
Low frequency oscillator	Frequency Range DC - 10 MHz variably attenuated output from 1 mV rms to 1 V or 5 V rms @ 50 ohms output impedance; selectable sinewave and square wave modes	Performance check calibration	HP 204 D
High frequency oscillator	Frequency Range 10 MHz - 1.3 GHz; variably attenuated calibrated output from 1 mV to 1 V or 5 V rms (50 ohms output impedance); CW mode	Performance check calibration	Wavetek 2001

EQUIPMENT TYPE	REQUIRED BASIC SPECIFICATIONS	WHERE USED	RECOMMENDED MANUFACTURER
RF Millivoltmeter	Frequency Range:10 kHz - 1.3 GHz; Volt. Range:1 mV - 5 V rms; Accuracy:maximum 3% of reading @ 1250 MHz + 1% full scale; VSWR: less than 1:1.15 @ 1.2 GHz Power Sensitivity:200 pW @ 50 ohms; Basic Accessories: a. 50 ohms BNC adaptor; b. TYPE N TEE ADAPTER unterminated	Performance check calibration	Boonton 92
Multimeter	Capable of measuring DC & AC voltage: DC & AC current Resistance	Troubleshooting	Dana 2000
Oscilloscope	DUAL TRACE: 100 MHz BANDWIDTH: 5 mV per division sensitivity; TIME BASE @ 0.05 us/div. with time delay features	Troubleshooting	Iwatsu SS-4121

4-3 SERVICE INFORMATION

4-4 Should your instrument need repair, send it to the factory. Check the warranty and shipping information inside the front cover.

4-5 GENERAL MAINTENANCE

4-6 ACCESS

4-7 Use the following procedure to gain access to the interior:

a. With the power switch OFF, disconnect the line cord.

b. Remove the four Phillips screws holding top cover.

c. Remove the four Phillips screws holding bottom cover.

4-8 CLEANING

4-9 Clean the front panel and case with denatured alcohol or mild solution of detergent and water.

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